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LEGISLATIVE HISTORY

Public Law 290---78th Congress

Chapter 172---2d Session

S. 1243

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DIGEST OF PUBLIC LAW 290

SYNTHETIC-FUEL DEMONSTRATION PLANTS. Authorizes appropriation of \$30,000,000, during a 5-year period, for construction and operation of synthetic-liquid-fuel demonstration plants. Provides that work on agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the Secretary of Agriculture's direction.

INDEX AND SUMMARY OF HISTORY ON S. 1243

June 18, 1943	S. 1243 introduced by Senator O'Mahoney and referred to the Senate Committee on Public Lands and Surveys. Print of the bill as introduced.
August 3, 1943	Hearings: Senate, S. 1243.
September 14, 1943	H. R. 3209 introduced by Rep. Randolph and referred to the House Committee on Ways and Means. Print of the bill as introduced.
October 6, 1943	Senate Committee reported S. 1243 with amendments. Senate Report 445. Print of the bill as reported.
October 12, 1943	Debated in Senate. S. 1243. Amendments agreed to.
November 1, 1943	House Committee reported H. R. 3209 with amendments. House Report 821. Print of the bill as reported.
November 5, 1943	Print of S. 1243 showing amendments agreed to.
November 9, 1943	S. 1243 debated in Senate and passed with amendments. Referred to House.
February 10, 1944	Rules Committee reported H. Res. 434 for the consideration of H. R. 3209. House Report 1115.
February 15, 1944	House debated H. R. 3209.
February 16, 1944	Debate continued. Passed House with amendments. Language of H. R. 3209 substituted in lieu of S. 1243.
March 3, 1944	House and Senate appointed Conferees.
March 28, 1944	Both Houses agreed to Conference Report. House Report 1302.
April 5, 1944	Approved. Public Law 290.

minion of Canada Branch, to have four Members of the Senate and four Members of the House of Representatives attend a meeting to be held in Ottawa, Canada, during the period June 26 to July 1, 1943, at which the Dominion of Canada Branch of the Empire Parliamentary Association will be host to a delegation from the United Kingdom Parliament and probably to delegations from the legislative bodies of Australia, New Zealand, and Bermuda. The President of the Senate and the Speaker of the House of Representatives are authorized to appoint the Members of the Senate and the Members of the House of Representatives, respectively, to attend such meeting and are further authorized to designate the chairmen of the delegations from each of the Houses. The expenses incurred by the members of the delegations appointed for the purpose of attending such meeting, which shall not exceed \$1,000 for each of the delegations, shall be reimbursed to them from the contingent fund of the House of which they are Members, upon the submission of vouchers approved by the chairman of the delegation of which they are members.

BILLS AND JOINT RESOLUTION INTRODUCED

Bills and a joint resolution were introduced, read the first time, and, by unanimous consent, the second time, and referred as follows:

Mr. McNARY. Mr. President, on behalf of the Senator from California [Mr. JOHNSON] who is detained from the Senate on account of illness I introduce a bill for appropriate reference.

By Mr. McNARY (for Mr. JOHNSON of California):

S. 1233. A bill to authorize the construction and maintenance of Moss Landing Harbor (Monterey Bay), California; to the Committee on Commerce.

By Mr. CAPPER:

S. 1234 (by request). A bill to amend section 8 of the act of May 29, 1930, as amended; to the Committee on Civil Service.

By Mr. WHERRY (for himself and Mr. BUTLER):

S. 1235. A bill for the relief of Nebraska Wesleyan University; to the Committee on Claims.

By Mr. VAN NUYS:

S. 1236. A bill to make it a criminal offense for certain escaped convicts to travel from one State to another; and

S. 1237. A bill to amend the law relating to larceny in interstate or foreign commerce; to the Committee on the Judiciary.

By Mr. THOMAS of Oklahoma:

S. 1238. A bill to authorize payment to attorneys representing Creek Nation of Indians;

S. 1239. A bill to authorize payment to attorneys representing Seminole Nation of Indians; and

S. 1240. A bill to authorize payment to certain enrolled members of the Seminole Tribe of Indians under act of July 2, 1942, Public, No. 645, Seventy-seventh Congress; to the Committee on Indian Affairs.

By Mr. McKELLAR:

S. 1241. A bill for the relief of the Canal Dredging Co. (with accompanying papers); to the Committee on Claims.

By Mr. BAILEY:

S. 1242. A bill to authorize appropriations for salaries and expenses, Office of Fishery Coordination; to the Committee on Commerce.

By Mr. O'MAHONEY:

S. 1243. A bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and

for other purposes; to the Committee on Public Lands and Surveys.

By Mr. THOMAS of Oklahoma:

S. J. Res. 66. Joint resolution consenting to an interstate oil compact to conserve oil and gas; to the Committee on Mines and Mining.

HOUSE BILLS REFERRED

The following bills were severally read twice by their titles and referred, as indicated:

H. R. 215. An act for the relief of Lorenzo H. Froman;

H. L. 255. An act for the relief of Col. E. H. Tarbutton;

H. R. 304. An act for the relief of J. E. Martin;

H. R. 305. An act for the relief of Howard Morgan;

H. R. 560. An act for the relief of the Farrell-Argast Electric Co.;

H. R. 563. An act for the relief of Joe Koor;

H. R. 636. An act for the relief of C. J. Toole;

H. R. 925. An act for the relief of the estate of Mathew C. Cowley, deceased, and the estate of Louisa Cowley, deceased;

H. R. 1155. An act for the relief of Capt. Leland M. Mower and Lt. Percy K. Morrison;

H. R. 1222. An act for the relief of Jacob Wolozin;

H. R. 1310. An act for the relief of Thula B. Wellborn;

H. R. 1313. An act for the relief of Delores Lewis;

H. R. 1334. An act for the relief of J. Frank Meador;

H. R. 1335. An act to provide for an appeal to the Supreme Court of the United States from the decisions of the Court of Claims in two suits instituted by H. B. Nelson (doing business as the H. B. Nelson Construction Co.);

H. R. 1344. An act for the relief of Paul W. Busbey, Mrs. Paul W. Busbey, Paula Busbey, and Mrs. Louisa Busbey;

H. R. 1379. An act for the relief of Gerald Estell Proctor;

H. R. 1498. An act for the relief of Charles W. Ruckman;

H. R. 1518. An act for the relief of Mrs. Bessie Pike and Mrs. Estelle Rosenfeld;

H. R. 1602. An act for the relief of Robert N. Bickert;

H. R. 1637. An act for the relief of Fred Hunter;

H. R. 1790. An act for the relief of Wymer Bowlin;

H. R. 1835. An act for the relief of Frederick Lee Littlefield;

H. R. 1872. An act for the relief of J. E. McCoy & Son;

H. R. 1889. An act for the relief of Andrew Williams;

H. R. 1907. An act for the relief of Anthony J. Leiberschal;

H. R. 2088. An act for the relief of John Rhoden;

H. R. 2152. An act for the relief of Rafael Torres;

H. R. 2299. An act conferring jurisdiction upon the United States District Court for the Eastern District of Arkansas to hear, determine, and render judgment upon the claims of W. M. Hurley and Joe Whitson;

H. R. 2544. An act for the relief of Bessie Myers; and

H. R. 2545. An act for the relief of Samuel J. D. Marshall; to the Committee on Claims.

H. R. 2935. An act making appropriations for the Department of Labor, the Federal Security Agency, and related independent agencies, for the fiscal year ending June 30, 1944, and for other purposes; to the Committee on Appropriations.

CONTINUATION OF THE COMMODITY CREDIT CORPORATION—AMENDMENT

Mr. TAFT submitted an amendment intended to be proposed by him to the bill

(S. 1108) to continue Commodity Credit Corporation as an agency of the United States, increase its borrowing power, revise the basis of the annual appraisal of its assets, and to provide for an audit by the General Accounting Office of the financial transactions of the Corporation, and for other purposes, which was ordered to lie on the table and to be printed.

PRINTING OF QUESTIONS AND ANSWERS ON THE TAX PAYMENT ACT OF 1943

The VICE PRESIDENT laid before the Senate House Concurrent Resolution 28, which was read, as follows:

Resolved by the House of Representatives (the Senate concurring), That the manuscript prepared by Representative DANIEL A. REED, containing an analysis of the current Tax Payment Act of 1943, entitled "Questions and Answers on the Tax Payment Act," be printed as a House document; and that 42,000 additional copies shall be printed, of which 30,000 shall be for the use of the House document room, 10,000 copies for the use of the Senate document room, 1,000 copies for the Committee on Ways and Means of the House, and 1,000 copies for the use of the Committee on Finance of the Senate.

Mr. HAYDEN. I move that the Senate concur in the House concurrent resolution.

The motion was agreed to.

FLAG DAY ADDRESS BY SENATOR BARKLEY

[Mr. HILL asked and obtained leave to have printed in the Record an address delivered by Senator BARKLEY at the Flag Day celebration, Hot Springs, Ark., on June 14, 1943, which appears in the Appendix.]

VICTORY DINNER ADDRESS BY SENATOR TRUMAN

[Mr. THOMAS of Oklahoma asked and obtained leave to have printed in the Record an address delivered by Senator TRUMAN at the Victory dinner at Oklahoma City, Okla., June 14, 1943, under the auspices of the Oklahoma Democratic State Committee, which appears in the Appendix.]

SUBSIDIES—ADDRESS BY SENATOR BUSHFIELD

[Mr. ROBERTSON asked and obtained leave to have printed in the Record a radio address on the subject of subsidies delivered by Senator BUSHFIELD on June 15, 1943, which appears in the Appendix.]

WINGS FOR THE FUTURE—ARTICLE BY SENATOR McCARRAN

[Mr. McNARY asked and obtained leave to have printed in the Record an article entitled "Wings for the Future," written by Senator McCARRAN and published in Shipmate for June 1943, which appears in the Appendix.]

STATEMENT BY BASIL MANLY CONCERNING THE FUNCTIONS OF THE FEDERAL POWER COMMISSION

[Mr. LA FOLLETTE asked and obtained leave to have printed in the Record a statement by Basil Manly, Vice Chairman of the Federal Power Commission, concerning the functions of the Federal Power Commission in relation to the supply of electricity and gas for war plants and establishments, which appears in the Appendix.]

ADDRESS BY HIS HOLINESS POPE PIUS XII TO THE WORKERS OF ITALY

[Mr. MURRAY asked and obtained leave to have printed in the Record an address delivered by His Holiness Pope Pius XII to the workers of Italy on June 13, 1943, which appears in the Appendix.]

THE ROLL-BACK AND SUBSIDY PROBLEM— STATEMENT BY ALBERT S. GOSS

[Mr. CAPPER asked and obtained leave to have printed in the RECORD a statement on the subject of the roll-back and subsidy problem, made by Albert S. Goss, master of the National Grange, before the Senate Committee on Banking and Currency, on June 15, 1943, which appears in the Appendix.]

ADDRESS BY JUAN T. TRIPPE ON INAUGURATION OF STRATOCOLLIPPER SERVICE TO CENTRAL AND SOUTH AMERICA

[Mr. OVERTON asked and obtained leave to have printed in the RECORD an address delivered at New Orleans, La., on June 12, 1943, by Juan T. Trippe, president of Pan-American World Airways, on the occasion of the inauguration of stratoclipper service between New Orleans and the Central and South American countries which appears in the Appendix.]

GOVERNMENT PURCHASE OF NEWSPAPER ADVERTISING—LETTER FROM RALPH W. PINKERTON

[Mr. BANKHEAD asked and obtained leave to have printed in the RECORD, a letter addressed to him from Ralph W. Pinkerton, of Ferndale, Wash., relative to the Government purchase of newspaper advertising, which appears in the Appendix.]

THE GASOLINE PROBLEM—ARTICLE BY IGOR CASSINI

[Mr. REYNOLDS asked and obtained leave to have printed in the RECORD an article relative to the gasoline problem, by Igor Cassini, published in the Washington Times-Herald, which appears in the Appendix.]

THE YARDSTICK OF CHRISTIANITY—LETTER FROM WALLACE C. SPEERS

[Mr. HOLMAN asked and obtained leave to have printed in the RECORD a letter addressed to him under date of June 9, 1943, by Wallace C. Speers, discussing Christianity as a yardstick in national affairs, which appears in the Appendix.]

THE TIMES TEST AND OUR PUBLIC SCHOOLS—PAPER BY PAUL BOYD

[Mr. CHANDLER asked and obtained leave to have printed in the RECORD a paper on the subject The Times Test and Our Public Schools, by Paul B. Boyd, dean of the college of arts and sciences, University of Kentucky, which appears in the Appendix.]

INDEPENDENT OFFICES APPROPRIATIONS—CONFERENCE REPORT

Mr. McKELLAR submitted the following report:

The committee of conference on the disagreeing votes of the two Houses on the amendments of the Senate to the bill (H. R. 1762) making appropriations for the Executive Office and sundry independent executive bureaus, boards, commissions, and offices, for the fiscal year ending June 30, 1944, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the Senate recede from its amendments numbered 2 and 6.

That the House recede from its disagreement to the amendments of the Senate numbered 7, 8, 9, 10, 11, 13, 17, 18, 20, 21, 22, 23, and 24; and agree to the same.

Amendment numbered 5: That the House recede from its disagreement to the amendment of the Senate numbered 5, and agree to the same with an amendment, as follows: In lieu of the sum proposed insert "\$125,000"; and the Senate agree to the same.

Amendment numbered 15: That the House recede from its disagreement to the amendment of the Senate numbered 16, and agree

to the same with an amendment, as follows: In lieu of the sum proposed insert "\$11,642,200"; and the Senate agree to the same.

Amendment numbered 19: That the House recede from its disagreement to the amendment of the Senate numbered 19, and agree to the same with an amendment, as follows: In lieu of the sum proposed insert "\$800,000"; and the Senate agree to the same.

The committee of conference report in disagreement amendments numbered 1, 3, 4, 12, 14, and 16.

RICHARD B. RUSSELL,
THEODORE FRANCIS GREEN,
KENNETH MCKELLAR,
GERALD P. NYE,
STYLES BRIDGES,

Managers on the part of the Senate.

C. A. WOODRUM,
JAMES M. FITZPATRICK,
JOE STARNES,
R. B. WIGGLESWORTH,
EVERETT M. DIRKSEN,
FRANCIS CASE,

Managers on the part of the House.

The report was agreed to.

The VICE PRESIDENT laid before the Senate a message from the House of Representatives announcing its action on certain amendments of the Senate to House bill 1762, which was read as follows:

IN THE HOUSE OF REPRESENTATIVES,
UNITED STATES,
June 16, 1943.

Resolved, That the House recede from its disagreement to the amendment of the Senate No. 1 to the bill (H. R. 1762) making appropriations for the Executive Office and sundry independent executive bureaus, boards, commissions, and offices, for the fiscal year ending June 30, 1944, and for other purposes, and concur therein with an amendment, as follows: In lieu of the sum inserted by said amendment insert "\$1,552,500."

That the House recede from its disagreement to the amendment of the Senate No. 3 to said bill and concur therein with an amendment, as follows: In lieu of the matter inserted by said amendment insert:

"NATIONAL RESOURCES PLANNING BOARD

"Salaries and expenses: For all expenses incident to the discontinuance of the work of the Board, including personal services in the District of Columbia and elsewhere, printing and binding, traveling expenses, and the payment of accumulated and accrued annual leave of employees of the Board due them after June 30, 1943, \$50,000: *Provided*, That the National Resources Planning Board is abolished effective August 31, 1943, and the functions exercised by such Board shall not be transferred to any other agency and shall not be performed after such date except as hereafter provided by law or as authorized in the ensuing proviso of this paragraph with respect to winding up the Board's affairs: *Provided further*, That the Director of the Board is authorized after August 31, 1943, and until January 1, 1944, to perform such duties and to exercise such administrative authority as may be incident to the effectuation of the discontinuance of the Board: *Provided further*, That the records and files of the Board shall be transferred to The National Archives.

"The appropriation herein made for the National Resources Planning Board shall constitute the total amount to be available for obligation by such agency during the fiscal year 1944 and shall not be supplemented by funds from any source."

That the House recede from its disagreement to the amendment of the Senate numbered 4 to said bill and concur therein with the following amendments: In line 22 of the matter inserted by said Senate engrossed amendment strike out "\$350,000" and insert "\$275,000"; and in line 27 of the matter in-

serted by said Senate engrossed amendment strike out all after "1943:" down to and including "studies" in line 28 and insert "*Provided*, That the foregoing total amount shall be so used as to complete the studies, investigations, and reports authorized and required by part I, title III, of the Transportation Act of 1940."

That the House recede from its disagreement to the amendment of the Senate numbered 12 to said bill and concur therein with an amendment as follows: In line 3 of the matter inserted by said Senate engrossed amendment strike out "\$10,000" and insert "\$9,000."

That the House recede from its disagreement to the amendment of the Senate numbered 14 to said bill and concur therein with an amendment as follows: In the last line of the matter inserted by said Senate engrossed amendment after "authorization" insert "*Provided*, That a report of such transfers and the savings effected thereby shall be submitted to Congress in the annual Budget."

That the House recede from its disagreement to the amendment of the Senate numbered 16 to said bill and concur therein with the following amendments: In line 10 of the matter inserted by said Senate engrossed amendment strike out "by July 1, 1945" and insert "at the earliest practicable date"; and in line 10 of the matter inserted by said Senate engrossed amendment after "shall" insert "by February 1, 1944."

Mr. McKELLAR. Mr. President, I intend to move that the Senate concur in the amendments of the House to the amendments of the Senate numbered 1, 3, 4, 12, 14, and 16, but before a vote is had, I wish to explain to the Senate just what is being done.

Senate amendment numbered 1 increased by \$205,000 the appropriation for the Bureau of the Budget. The House concurred in the Senate amendment with an amendment restoring \$102,500 of the \$205,000 which the House had cut out. This is an amendment in which the junior Senator from Georgia [Mr. RUSSELL] is greatly interested, and he has informed me that he is agreeable to the amendment made by the House.

I am not sure but that the amendments should be separately voted on, and I ask for a vote on the amendment of the House to the amendment of the Senate numbered 1. I move that the Senate concur in the amendment of the House to the amendment of the Senate numbered 1.

The motion was agreed to.

Mr. McKELLAR. The next amendment is one about which there has been a great deal of controversy, as Senators all know. It relates to the National Resources Planning Board. The Senate adopted an amendment continuing the Board, and appropriating \$200,000 for that purpose. The House had proposed to abolish the Board entirely. Yesterday the House, on motion, agreed to an appropriation of \$50,000 to wind up the affairs of the Board, and I shall move to concur in the amendment of the House.

I wish to say, in explanation, that there will be \$42,500 due employees of the Board for leaves of absence, and the \$50,000 will not be sufficient to pay that sum and take care of the other necessary expenses, but rather than not let the bill go through at this time, I shall move to concur in the amendment of the House, and let that be the end of the

you inquire as to the intensity with which tank trucks are employed in our efforts to transport petroleum supplies to the east coast.

First, may I point out that contrary to the advice given you, there are only about 105,000 tank trucks in the United States: Of these, 92,000 are marketing tank wagons used solely in the retail delivery of petroleum products and range in size from 500 to 2,500 gallons. The great majority of these are approximately of 1,000-gallon capacity. The balance of petroleum trucks on the road, roughly 13,000 in number, are classified as "transport units." These range in size from about 3,000 to 10,000 gallons, depending entirely upon the State laws in force in the States in which they operate.

Although it might be presumed that rationing has lessened the use of petroleum motortrucks throughout the country, such is not the case; nor would further rationing throughout the country in those areas not now as severely rationed as the east coast create idle transport truck capacity useful to the east coast. The most efficient sphere of operation of a transport type truck is in short-haul service in the replacement of tank cars. We have concentrated on substituting petroleum motor transports for tank cars throughout the whole country, and by so doing, we have gained from petroleum district No. 2, approximately 20,000 tank cars formerly used within that district and now employed in the long-haul service between the Southwest and the east coast. This campaign of substitution has employed fully every transport in the entire petroleum district No. 2, and we find that there are still many tank cars engaged in short-haul movements of essential industrial oils in that district for want of additional truck equipment.

Insofar as petroleum district No. 3 is concerned, there is an acute shortage of petroleum tank trucks of all types in the petroleum industry. This was brought about by our efforts to place rail short-haul movements upon trucks and the tremendous increase in military demand for both aviation and automotive gasolines in that district. Petroleum districts Nos. 4 and 5 are dependent upon motortrucks to a great extent, and there is no idle truck capacity in those districts. Within petroleum district No. 1, the east coast, there are at the present time some idle petroleum transports. This idleness is seasonal, however, and not brought about entirely by wartime conditions. In order that the personnel of the transport companies and the driver personnel of the oil companies can be maintained, we are making every effort to schedule certain movements within petroleum district No. 1 which normally move by rail, but which could move by motortruck.

I presume that you contemplate the employment of motortrucks to assist in bringing additional petroleum supplies into Petroleum District 1. Because of the scarcity of supplies it would be necessary to send such idle trucks as we could find unnaturally long distances to obtain the products desired. An operation of great distance is not feasible under present conditions for several reasons: First, because of State laws governing the size, weight, and licensing fees which vary widely; second, because of the labor problem involved requiring many times the number of drivers now employed; third, maintenance problems which, because of the age of trucks now on the road, is highly important; and fourth, the fact that such an operation would wear out many trucks so used in a comparatively short time. This would make necessary the manufacture of replacements involving the use of critical production facilities for very little net return in terms of barrels per day of petroleum moved. It must be remembered, too, that

September will see the complete reemployment of any trucks now idle on the eastern seaboard in their normal activity of distributing fuel oil as well as other petroleum products.

All of the above has reference to the type of truck which we call transports. The tank wagon, retail delivery units, have not been considered because of the nature of their construction. They are small in the main, old, and sorely needed for local distribution, particularly in agricultural areas. A 1,000-gallon tank wagon operated between Texas and, let us say, New York could not be expected to deliver more than 4,000 gallons a month, a little over 3 barrels per day, if it were in continuous operation. Because of manpower and maintenance problems it would probably produce much less.

In conclusion, may I say that we are making every effort to employ motor units fully, but we are concentrating upon substituting them for inefficient rail transportation movements and are using the rail tank cars gained by this substitution to serve the east coast. Wherever we see any possibility of augmenting eastern supplies by the use of motor transports, we are very quick to employ them, but we feel that we must weigh the gains of such a movement against the inefficiency and waste of transportation equipment which might result from improper use of this form of transport. Our greatest concern is that these vehicles shall be maintained and operated in the service in which they are most useful as further construction of this equipment is necessarily limited.

Thank you for the opportunity that you have afforded us to comment upon this phase of our petroleum transportation activities. If there is any further information which you would care to have in this connection, please let me know.

Sincerely yours,

HAROLD L. ICKES,

Petroleum Administrator for War.

PRODUCTION OF SYNTHETIC FUELS

Mr. O'MAHONEY. Mr. President, earlier in the day I introduced a bill to authorize the Department of the Interior, through the Bureau of Mines, to establish and operate plants for the production of synthetic fuels.

This bill is the outgrowth of studies which have been made by the Committee on Public Lands and Surveys, by the Department of the Interior, and by the Bureau of Mines. A year ago, when the Secretary of the Interior appeared before the Appropriations Committee, he discussed the hydrogenation of coal with members of the committee. At that time an appropriation was made to allow certain tests to be carried on by the Bureau of Mines in one of its establishments. Those tests, together with the experience of Great Britain, Germany, and Japan, indicate that it is of the utmost importance that this country undertake immediately to develop its resources for the manufacture of synthetic fuels.

We stand in danger of being faced by—one might almost say—a scandal comparable to that surrounding the failure to produce synthetic rubber. Everyone knew that the country was dependent upon outside sources for its supply of rubber. There was knowledge in high places that newly patented devices and new scientific discoveries made possible the manufacture of synthetic rubber. Nothing was done, though the great need was apparent everywhere. The need now for petroleum and its products, including gasoline, and all the other types of

liquid fuel, is apparent to everyone. We need it not only for civilian industry, but we need it also for the successful prosecution of the war. The purpose of this bill is to authorize the country to meet this need before it becomes so acute that disaster may follow.

I ask unanimous consent to have printed in the RECORD at this point as a part of my remarks my letter to the Secretary of the Interior with respect to this measure and his response.

There being no objection, the correspondence was ordered to be printed in the RECORD, as follows:

JUNE 8, 1943.

HON. HAROLD L. ICKES,
Secretary of the Interior,
Washington, D. C.

DEAR MR. SECRETARY: It is daily becoming more and more clear that the full utilization of the country's supply of coal, oil shale, and other substances from which synthetic liquid fuel can be manufactured is essential if the Nation's needs, both in war and in peace, are to be met. As the hearings before the Western Minerals Resources Subcommittee of the Senate Committee on Public Lands have demonstrated our petroleum reserves are declining. Although the passage of the act of December 24, 1942, has greatly stimulated the search for oil on the public domain, the demand for fuel is so great that we cannot safely depend upon petroleum alone.

These same hearings have shown the existence in the United States of vast and practically unlimited deposits of coal as well as huge resources of undeveloped oil shale. Except for the work which the Department of the Interior has undertaken through the Bureau of Mines under appropriations heretofore made by the Congress for the study of the hydrogenation of coal, little has been done in this country to make certain that we shall be fully ready for the manufacture of large quantities of synthetic fuels to meet future needs. That these needs will be very great, the development of aviation already accomplished as a result of the war proves beyond any question. Already the nations of the world are looking forward to the problems of international air commerce after the war. Without a full and certain supply of liquid fuel, the United States may find itself unable to realize its full possibilities in air commerce.

The testimony of your experts before the Public Lands Committee indicates that Germany, England, and Japan have all used coal extensively for the manufacture of liquid fuel. Indeed, it is unlikely that Germany could have maintained its war machine without the motor fuel it has manufactured from coal. The results which have been accomplished in England seem to give assurance that that country will be fully supplied with synthetic fuels after the war.

The sad experience which we have had with rubber should be sufficient to warn us against a repetition in the case of motor fuel. We had made little or no advance preparation for the development of synthetic rubber and when the natural supplies were cut off, we found ourselves in a desperate situation. This can be avoided with respect to synthetic fuel if we act now.

I know from your own testimony before the Senate Appropriations Committee and from my conversations with you and members of your staff that you are fully aware of the gravity of the problem. Both as Secretary of the Interior and as head of the Petroleum Administration for War, you are in a position to carry out a most effective and beneficial program for the development of synthetic fuel. It will be necessary, as you know, to provide legislative authorization if the Bureau of Mines is to be enabled to take the necessary steps to construct and operate demonstration plants to make fuel

from coal, shale, and other suitable materials. The Western Mineral Resources subcommittee will be very glad to cooperate with you in the preparation of legislation to this effect and in outlining a public hearing through which the country will be advised not only of the need of an immediate program of this character, but of the existence in this country of the natural resources which are sufficient to keep the United States in its present position of leadership in all phases of industry, transportation and commerce which depend upon liquid fuel.

If you will suggest the terms of legislation which, in your opinion, are necessary to provide authorization for this work, I shall be very glad indeed to introduce a bill and to arrange for a hearing by the Western Minerals subcommittee.

Sincerely yours,

JOSEPH C. O'MAHONEY.

THE SECRETARY OF THE INTERIOR,
Washington, June 16, 1943.

Hon. JOSEPH C. O'MAHONEY,
United States Senate.

MY DEAR SENATOR O'MAHONEY: Your letter of June 8 expressing briefly your views on the advisability of a synthetic liquid fuel program strikes directly home on a matter of paramount importance. I hasten to comply with your wish that I suggest legislation to meet the situation. My Department will endeavor to make an adequate presentation of this matter before a Senate committee as you request.

You are absolutely correct, according to my way of thinking, that this country can no longer delay in embarking upon a synthetic fuel program. Those in my Department who are authorities on petroleum are in agreement with this idea. Our continuing study of reserves and the rate of depletion indicates clearly that unless we take action the end of the gasoline age is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, certain bureaus of the Department of the Interior are and have been aware of these trends and steps may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

The time has come when we must get out of the test-tube stage into actual production. Past experiments have given us the scientific know-how but the way must be blazed for American industry to enter this synthetic fuel field, which inevitably will be one of the major industrial developments of the near future.

It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly. Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up the work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that it can take up the task of providing synthetic fuels on the scale necessary to safeguard this Nation's future.

Whether or not special legislation is technically necessary for this purpose, the problem is of such importance that it should be adequately presented to Congress and I, therefore, enclose suggested authorization

legislation and await a hearing by Congress, which I hope will be available at an early date. The hour is already late and action cannot be delayed unless this country is prepared at some future date to undergo sacrifices and turmoil that would make our difficulties in establishing a synthetic-rubber program seem insignificant by comparison.

I have instructed Michael W. Straus, First Assistant Secretary of the Department of the Interior; Dr. R. R. Sayers, Director of the Bureau of Mines; Dr. A. C. Fieldner, Chief, Fuels and Explosive Service of the Bureau of Mines, and all agencies of the Department to take whatever steps may be necessary so that there may be a suitable presentation to the Congress of the problem and the solution.

Sincerely yours,

HAROLD L. ICKES,
Secretary of the Interior.

AUTHORIZATION FOR COMMITTEE REPORTS, ETC.

Mr. McKELLAR. Mr. President, I understand that at the conclusion of today's session the Senate will adjourn until Tuesday next. In the meantime the Committee on Appropriations may possibly be in position to report at least two bills. I ask unanimous consent that during the adjournment or recess of the Senate following today's session, authority be given to the Committee on Appropriations to submit reports, including notices of motions to suspend the rule, and such amendments as may be offered.

The PRESIDING OFFICER. Without objection, it is so ordered.

BURTON S. RADFORD

Mr. ELLENDER. Mr. President, when the calendar was called on June 15, 1943, Senate bill 1087 was passed without objection. There came from the House today House bill 2556, which is an identical bill with the one to which I have just referred. I ask that the Chair lay before the Senate H. R. 2556.

The PRESIDING OFFICER laid before the Senate the bill (H. R. 2556) for the relief of Burton S. Radford, which was read twice by its title.

Mr. ELLENDER. Mr. President, I ask unanimous consent that the Senate proceed to the consideration of House bill 2556.

The PRESIDING OFFICER. Is there objection to the present consideration of the bill?

There being no objection, the bill (H. R. 2556) was considered, ordered to a third reading, read the third time, and passed.

RELIEF OF ARMY DISBURSING OFFICERS

Mr. REYNOLDS. Mr. President, I wonder if the Senate would be good enough to grant unanimous consent for me to bring to its attention three bills which are on the calendar. Two of the bills have been on the calendar for several months, and the remaining one has been on the calendar for 30 or 40 days.

Mr. McNARY. I earlier objected to one of the bills, not because of the substance of it, but because of the absence from the Senate of certain Senators on official business. I have conferred with some of the members of the committee, and have ascertained that they have no objection. I have no objection. If the Senator from North Carolina will make

appropriate statements with regard to the bills I shall appreciate it.

Mr. REYNOLDS. I shall be glad to do so. Mr. President, I first ask unanimous consent that the Senate proceed to the consideration of Senate bill 218, to authorize relief of disbursing officers of the Army on account of loss or deficiency of Government funds, vouchers, records, or papers in their charge.

The Navy has already been given the same consideration which is provided for in the bill. It was granted several years ago.

The PRESIDING OFFICER. Is there objection to the present consideration of the bill?

There being no objection the bill (S. 218) to authorize relief of disbursing officers of the Army on account of loss or deficiency of Government funds, vouchers, records, or papers in their charge was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted etc., That the General Accounting Office shall relieve any disbursing officer of the Army charged with responsibility on account of loss or deficiency while in the line of duty, of Government funds, vouchers, records, or papers, in his charge, where such loss or deficiency occurred without fault or negligence on the part of said officer: Provided, That the Secretary of War shall have determined that the officer was in the line of his duty, and the loss or deficiency occurred without fault or negligence on his part: Provided further, That the determination by the Secretary of War of the aforesaid questions shall be conclusive upon the General Accounting Office: Provided further, That all cases of relief granted under this authority during any fiscal year shall be reported in detail to the Congress by the Secretary of War: And provided further, That this Act shall be applicable only to the actual physical loss of Government funds, vouchers, records, or papers, and shall not include deficiencies in the accounts of disbursing officers of the Army resulting from illegal or erroneous payments.

TRAVEL COSTS OF DEPENDENTS OF MILITARY AND CIVILIAN PERSONNEL

Mr. REYNOLDS. Mr. President, I now ask unanimous consent that the Senate proceed to the consideration of Senate bill 220, to provide for payment of certain travel costs of dependents of military and civilian personnel of the Army and the War Department on a mileage basis in order to promote efficiency and economy in such payments.

The bill would provide for the payment of certain travel costs of dependents of military and civilian personnel. At the present time it is necessary to have rate experts calculate the cost of transportation from one place to another of the families of Army and civilian personnel, and the Army desires the opportunity to decentralize the payments to field offices, and pay straight fare to the nearest point at 4 cents a mile for adults, and 2 cents a mile for children. It is said that the bill would save the Government considerable money, and the Bureau of the Budget has no objection to it whatever.

Mr. McNARY. Would the bill result in additional expense?

Mr. REYNOLDS. Not at all. It would lessen the present expense.

78TH CONGRESS
1ST SESSION

S. 1243

IN THE SENATE OF THE UNITED STATES

JUNE 18 (legislative day, MAY 24), 1943

MR. O'MAHONEY introduced the following bill; which was read twice and referred to the Committee on Public Lands and Surveys

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That the Secretary of the Interior, acting through the
4 Bureau of Mines, within the limits of critical materials
5 available, is authorized to construct, maintain, and operate
6 one or more demonstration plants to produce synthetic liquid
7 fuels from coal and other substances with all facilities and

1 accessories for the manufacture, purification, storage, and
2 distribution of the products.

3 SEC. 2. In order to carry out the purpose of this Act,
4 the Secretary of the Interior is authorized—

5 (a) to conduct laboratory research and develop-
6 ment work necessary to determine the best demonstra-
7 tion plant designs and conditions of operation;

8 (b) to acquire, by purchase, lease for a term of
9 years or less, donation, or otherwise, land and any
10 interest in land, including easements and leasehold in-
11 terests; options on real or personal property; plants
12 and their facilities; secret processes, technical data,
13 inventions, patent applications, patents, irrevocable non-
14 exclusive licenses, and other rights and licenses under
15 patents granted by this or any other nation; to assume
16 the obligation to pay rentals in advance on property so
17 acquired, and to pay damages arising out of the use of
18 any such property;

19 (c) to engage, by contract or otherwise, engineers,
20 architects, and any private industrial organization he
21 deems suitable, to do all or any part of the work of
22 designing, constructing, or operating the plants, the
23 operation to be under his supervision, and through
24 leases or otherwise as he believes advisable;

25 (d) to cooperate with any other Federal or State

1 department, agency, or instrumentality, and with any
2 private person, firm, or corporation, in effectuating the
3 purposes of this Act.

4 Sections 321 and 322 of the Act of June 30, 1932 (47
5 Stat. 412), as amended, shall not apply to any leases under
6 this section; and such leases may be made for a term of
7 years notwithstanding Revised Statutes, section 3679, as
8 amended, or any other provision of law.

9 SEC. 3. The Secretary of the Interior is authorized to
10 sell the products of the plants at not more than actual cost,
11 including amortization of capital expenses, as determined by
12 him, to any department, agency, or instrumentality of the
13 Federal or any State government, but priority shall be given
14 to orders placed by the War or Navy Departments. Any
15 remaining products may be sold at going prices to any
16 purchaser. The Secretary of the Interior, in his discretion,
17 shall also have authority to dispose of any lands or other
18 real or personal property acquired, but in his opinion no
19 longer useful, for the purposes of this Act, and to grant, on
20 such terms as he may consider appropriate, licenses under
21 patent rights acquired under this Act.

22 SEC. 4. All moneys received under this Act for products
23 of the plants and royalties shall be paid into the Treasury
24 as miscellaneous receipts. The Secretary of the Interior shall

1 render to Congress on or before the first day of January of
 2 each year a report of all operations under this Act.

3 SEC. 5. The Secretary of the Interior may issue rules
 4 and regulations to effectuate the purposes of this Act. The
 5 authority and duties of the Secretary of the Interior under
 6 this Act shall be exercised through the Bureau of Mines of
 7 the Department of the Interior.

78TH CONGRESS
 1ST SESSION

S. 1243

A BILL

Authorizing the construction and operation of
 demonstration plants to produce synthetic
 liquid fuels from coal and other substances,
 in order to aid the prosecution of the war,
 to conserve and increase the oil resources
 of the Nation, and for other purposes.

By Mr. O'MAHONEY

JUNE 18 (legislative day, May 24), 1943
 Read twice and referred to the Committee on Public
 Lands and Surveys

LEGISLATIVE SERVICE
OFFICE OF CLERK OF THE SENATE

FILE COPY

SYNTHETIC LIQUID FUELS

FILE COPY HEARINGS

BEFORE A

SUBCOMMITTEE OF THE
COMMITTEE ON PUBLIC LANDS AND SURVEYS
UNITED STATES SENATE
SEVENTY-EIGHTH CONGRESS

FIRST SESSION

ON

S. 1243

A BILL AUTHORIZING THE CONSTRUCTION AND OPERATION
OF DEMONSTRATION PLANTS TO PRODUCE SYNTHETIC
LIQUID FUELS FROM COAL AND OTHER SUBSTANCES,
IN ORDER TO AID THE PROSECUTION OF THE
WAR, TO CONSERVE AND INCREASE THE
OIL RESOURCES OF THE NATION, AND
FOR OTHER PURPOSES

WASHINGTON, D. C.—AUGUST 3, AND 4, 1943

PITTSBURGH, PA.—AUGUST 6, 1943

SALT LAKE CITY, UTAH—AUGUST 9, 1943

SHERIDAN, WYO.—AUGUST 11, 1943

Printed for the use of the Committee on Public Lands and Surveys





SYNTHETIC LIQUID FUELS

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COMMITTEE ON PUBLIC LANDS AND SURVEYS
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SEVENTY-EIGHTH CONGRESS

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SYNTHETIC LIQUID FUELS

TUESDAY, AUGUST 3, 1943

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON
PUBLIC LANDS AND SURVEYS.

Washington, D. C.

The subcommittee met, pursuant to call, at 10 a. m., Senator Joseph C. O'Mahoney (chairman) presiding.

Present: Senator O'Mahoney (chairman), Senator Murdock, and Senator Gurney; Congressman Jennings Randolph, chairman of a similar subcommittee of the Committee on Mines and Mining of the House of Representatives; Congressman Grant Furlong; and W. H. McMains, clerk of the Senate Committee on Public Lands and Surveys.

Senator O'MAHONEY. The committee will please come to order.

I think it would be well to begin the record by printing the full text of the bill, S. 1243, to authorize the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

(S. 1243 is as follows:)

[S. 1243, 78th Cong., 1st Sess.]

A BILL Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products.

SEC. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, donation, or otherwise, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to

be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this Act.

Sections 321 and 322 of the Act of June 30 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful for the purposes of this Act, and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act.

SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this Act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this Act. The authority and duties of the Secretary of the Interior under this Act shall be exercised through the Bureau of Mines of the Department of the Interior.

Senator O'MAHONEY. It was to make certain that the country should not find itself without gasoline and oil when the supplies of petroleum proved to be inadequate to meet the mounting needs for gasoline and oil for war purposes, and for civilian purposes that the bill was introduced.

I think Secretary Ickes and the Bureau of Mines are to be complimented on the fact that under the direction of the Secretary, the Department of the Interior has already taken substantial steps toward clearing the way for the production of synthetic fuels. I think it was 2 years ago that the Appropriations Committee of the Senate provided funds for the Bureau of Mines to begin experimenting with the hydrogenation of coal in the Bureau of Mines plant at Pittsburgh. That has been done, and this committee will visit the plant at Pittsburgh before the end of the week to see the demonstration there of what has already been accomplished.

But much greater work needs to be done. The coal and oil shale available to this country, not only in the West but elsewhere, is sufficient to supply all our needs for liquid fuel. We should not permit ourselves to be caught short with respect to fuel as we are with respect to rubber.

I am very happy to have the opportunity of calling upon Secretary Ickes now, not only because this is an attempt to solve a problem which is recognized wherever petroleum and petroleum products are used, but because also it seems to me to offer a constructive step toward the solution of our employment problem after the war. It is work that will furnish jobs for returning soldiers. This is the opportunity, and it is the first step in that direction.

I will be very glad now to call on Secretary Ickes to explain the bill from the point of view of the Department of the Interior.

STATEMENT OF HON. HAROLD L. ICKES, SECRETARY OF THE INTERIOR AND PETROLEUM ADMINISTRATOR FOR WAR

Secretary ICKES. Mr. Chairman and gentlemen, I urgently recommend approval of S. 1243, introduced by Senator O'Mahoney, and now under consideration by this joint committee of Congress. Enactment into law of the bill which authorizes the Government to build and operate demonstration plants for producing gasoline and oil from coal and other substances, is, in my judgment, an immediately important step in safeguarding the future of the petroleum supply in this country. My reasons for supporting S. 1243 may be well known to all or most of you, since I have many times stated my position on the basic facts involved, but for the record I welcome this opportunity to repeat them here.

For more than a quarter of a century gasoline and oil have provided conveniences, luxuries, and security for a people whose mode of living is the cynosure of the entire world. We depend on petroleum and petroleum products for the continued operation of the internal combustion engine in automobiles, trains, ships, and planes, and in many factories; we rely on them more or less for the production of lubricants, protective coatings and wrappers, waxes, chemicals, explosives, medicinals, cosmetics, preservatives, soaps, building materials, waterproofing, and fire-resistant materials, antifreeze solutions, and for fuel in power and heating plants.

An abundance of relatively cheap fuel throughout the years since the great gushers began to flow has given us a multitude of material blessings, and has instilled in us a sense of security that is enjoyed by no other nation. Whether or not these material blessings are ephemeral and how much of our security is false, only time will tell. Nevertheless, nearly two generations of our people have come to depend upon the magic fluid for many of the essentials and pleasures of life, and its influence is reflected in the fabric of our entire social and economic order.

A sudden cessation or curtailment of petroleum and its products would dislodge and upset the system to which we have become accustomed, and which we regard as part of our indefeasible rights. No man can predict accurately the vast ramification involved in a changing economy such as would result from a cutting off of gasoline and oil, but I do say that it would be of momentous consequence, attended by confusion, deprivation, and a possible decline in world power and prestige.

We should not have waited until a war was upon us to begin seriously the development of synthetic fuels, but since we did that very thing, I submit that now it is high time to get started on an adequate scale. The quickest way to atone for past heedlessness is to approve S. 1243 immediately, quit our reliance upon a sense of security that may not have had the firmest foundation, and get going. Why must we do this? Have we not enough petroleum to last for ages? Can we not continue to rip and roar through an endless golden age of gasoline? My answer is an emphatic "No!"

It is no secret that our known petroleum reserves are limited, and that the time may not be far distant when they will be inadequate.

I have stated this fact on other occasions and I reiterate it here. For several years past we have been consuming petroleum nearly three times as fast as we have been able to discover new sources. Extensions of the older fields, plus the new discoveries that have been made, have maintained our proved reserves at nineteen to twenty billion barrels. We have been using about one and four-tenths billion barrels a year. Thus, our known reserves are equal to a 14- or 15-year supply.

But we cannot count on an adequate supply for each of the potential 14 or 15 years, because existing wells will begin to slow down in production as time goes on.

Senator O'MAHONEY. Mr. Secretary, may I interrupt you to remark here that as a result of the bill which this committee recommended to the Congress in the last session, and which was approved by you, the act of December 24, 1942, which provided a reward for discovery of oil on the public domain by reducing the royalty for a period of years to a flat 12½ percent, that law has resulted in the discovery, I am now informed, of something like 80,000,000 barrels of new reserves in the State of Wyoming alone. That, of course, does not begin to be sufficient to meet the needs for war and for civilian purposes, and does not at all militate against this bill.

The truth is that the difficulties of exploration on the public domain for new sources of oil only emphasize the need of attacking this problem as we are doing.

Secretary ICKES. Yes, sir.

It actually would take about 50 years to remove all of the known available oil from the ground, and the 15-year reserves would have to be produced over a period of half a century, during which we would either have to supplement our growing needs by importations or by turning to sources other than natural crude.

The discovery of new oil fields doubtless will increase the known reserves, although geologists have warned us that discovery cannot keep pace with present consumption. And future consumption will probably exceed that of the present. Moreover, it is entirely possible that increasing military demands, together with the chance that there may have been errors in estimates, may result in much more rapid depletion than we had anticipated.

We are doing as much wildcat drilling now as ever; we are bringing in about as many new wells in new fields as we have done in comparable periods in the past, but the new wells have only a fraction of the capacity of those brought in during previous years. In the meantime the producing wells are declining in output.

The idea that, somehow or other, sufficient new reserves of petroleum always will be discovered has its roots in wishful thinking. Natural petroleum does not accumulate like weeds, and we cannot produce more and more of it as we are able to grow trees through reforestation. Petroleum was made by Nature many ages ago, and Nature isn't making it at the rate that we are using it.

It would be foolhardy for me or for anyone else to predict that we will be without petroleum in 5 years, 10 years, or even 20 years. It may be taken for granted that our petroleum reserves are at a low level, but I leave to others the satisfaction of arguing whether there are fifteen or twenty or twenty-five billion recoverable barrels left, or whether there is enough for a decade or for two decades. There is

sufficient evidence as to supply to warrant, or rather to require, that we, as a prudent people, take out insurance against the future.

Already we have had a taste of what may come in future years. During this war we have learned that an ordered scheme of living can change radically overnight. Two years ago a man who would have predicted a shortage in 1943 of the many everyday, common commodities that we now go without, would have been questioned as to his sanity. In the "fill 'er up" days of 1940 and 1941, motorists would not believe that they would face the fact of gasoline rationing, or that their automobiles and trucks would be limited to essential uses.

We must insure our future security by launching a synthetic fuel program as embodied in the bill now under consideration, and we must do it without delay. It is unlikely that private capital will venture into a new and untried industry, no matter how bright the prospects may appear. There are too many unanswered questions, too many formulas to be worked out, and too many experiments yet to be conducted. The Federal Government is the logical organization to do the spade work, and this bill provides the means.

In a synthetic fuel program, a primary consideration is the availability of the raw materials. In this respect the United States stands in an enviable position. Our coal reserves have barely been scratched and we can count about 3 trillion tons left in the ground. It is estimated that this much coal could provide 1.5 billion barrels of synthetic liquid fuel each year for 1,000 years and still have enough coal to use for all other present-day purposes. We have oil shale deposits, principally in the Rocky Mountain States, estimated to contain 92,000,000,000 barrels of crude oil—enough to supply our needs for 65 years or more.

Senator O'MAHONEY. May I interrupt you again to remark, Mr. Secretary, that the presence of these oil shale deposits in Utah, Colorado, Wyoming, and elsewhere in the West has been known for years, but nothing has been done, in a substantial way at least, to make oil from the oil shale, although it is known scientifically that it can be done.

The fact that they have been permitted to lay there undeveloped for so many years is, to my mind, an indication of how important it is to have the Government step out in advance and show how it can be done in a demonstration plant.

Secretary ICKES. I think that is very true.

These vast resources remain in the ground and await utilization only because we have not developed adequate commercial methods for converting them into usable liquid fuels. By "commercial methods" I mean methods permitting large-scale production by private industry, with reasonable profits to the manufacturer and fair costs to the consumer. I state to you frankly that if natural petroleum were cut off tomorrow, we would not be able to produce enough synthetic fuel from coal and oil shale within a year to supply our needs for 24 hours.

One of the bright spots in the domestic situation lies in the fact that 8 years ago scientists in the Bureau of Mines had the foresight to begin an investigation of the hydrogenation of coal to produce synthetic fuels. We asked Congress for funds in 1935, and 2 years later the first drop of oil flowed from the Bureau's small-scale direct-hydrogenation plant at Pittsburgh.

Throughout the intervening years the Bureau of Mines engineers have experimented with a laboratory-size plant, improved the technique, and brought their work up to date so far as possible with the limited funds and equipment at their command. Fourteen American and Alaskan coals have been tested in this small plant, which handles only 100 pounds of coal a day, and the scientists have proved that most of the Nation's bituminous coals and lignites can be liquefied. The yields run from 32 to 70 gallons of crude oil for each ton of coal or lignite. The plant is still operating, producing its dribblets of gasoline, Diesel oil, and other valuable byproducts. Experiments are still going forward to determine additional uses in industry for the oil, gasoline, and byproducts.

Last year Congress appropriated funds for small-scale experiments in another coal hydrogenation process, and this work is getting under way at the Pittsburgh plant. However, both experiments are on such a small scale that there is a wide gap between them and the commercial production of synthetic liquid fuel.

From 1925 to 1929 the Bureau of Mines also experimented in the recovery of oil from shales near Rulison, Colo., and proved by pioneer work that oil could be extracted successfully. Before a shortage of funds stopped the work, the technologists had mined and retorted approximately 6,000 tons of oil shale and produced 3,600 barrels of oil. Like coal hydrogenation, this work was on a very small scale and no commercial-size production operations were attempted.

Neither the coal reserves nor the oil shales will deteriorate and they are there for the taking at any time. The point is that we should be ready to utilize them when the occasion arises, and we shall not be able to do so unless we develop feasible plans and workable methods without further loss of time. The Bureau of Mines engineers and other experts who will follow me before this committee can provide the necessary technical information, describe the various processes, and recommend specific plants and equipment. My aim is to stress the need for immediate action, for bridging the gap between the little that we know and the great deal that we must learn, and for preparing ourselves against the day when our natural petroleum reserves may be depleted.

We can take a lesson from one Adolf Hitler in the matter of synthetic gasoline, since he used it to overrun western Europe and the Lowlands, to conquer Greece, and propel Rommel's African tanks. In 1930 a large hydrogenation plant in Germany was producing 30,000,000 gallons of gasoline a year, and 6 years later this and three other plants were turning out more than 200,000,000 gallons. The last fairly definite figures we had from Germany in 1939 revealed that the Nazis were getting about 1,000,000,000 gallons of gasoline a year from coal, and today the figure may be nearer 2,000,000,000.

England, too, has been producing gasoline from coal since 1935 and her plants have provided millions of gallons of fuel for war planes and other machines.

Hitler's formulas are secret, of course, but we know a good deal about his plants. While we count on some assistance from Britain, nevertheless, we must build our plants of American materials, use American methods, and adapt the process to American coals. This calls for research and investigation, and for actual construction and operation on a commercial scale.

In an article that I prepared for a recent issue of *Coal Age*, I explained that the work on oil shales and on coal hydrogenation processes might have to be carried on simultaneously for the simple reason that we may have to rely simultaneously on both coal and oil shales when the crisis in our natural petroleum becomes more acute.

Commercial-scale investigations of coal hydrogenation methods would pave the way for far-reaching research in the field of chemistry because the list of chemicals which can be obtained by liquefying coal reads like a Who's Who. From these chemicals we can get ingredients for plastics, sulfa drugs, dyes, lacquer solvents, explosives. We can get materials for synthetic fibers and perfumes and synthetic rubber.

Despite their limited facilities, Bureau of Mines research workers are making real progress in untying various knots to reveal the secrets contained in coal. They are working on methods of improving the octane content of gasoline obtained from coal and are shaping the keys to unlock doors leading to new avenues of usefulness for the various other products of coal liquefaction.

I do not mean to imply that all of the research work has been performed by the Bureau of Mines. Other research agencies and industrial laboratories have contributed important information on the chemistry of coal and its utilization. The assistance of every agency is needed in this project.

Gentlemen, this is not a promise to make synthetic fuel cheaper than natural petroleum products. It is a proposal to blaze the path now for private capital to do this job when we have no more natural domestic petroleum and it becomes a question of synthetic liquid fuel or the end of the gasoline age. Competition with the petroleum industry is not contemplated, the contrary rather, in this plea for synthetic-fuel research. The future of the Nation is at stake.

The Bureau of Mines by its work today seeks merely to prepare to meet a crisis tomorrow. I repeat, we do not know definitely how long our petroleum reserves will last. We cannot predict how long this war will last, either, or how severely our natural petroleum reserves will be taxed before the peace is written.

We can survive a potato shortage indefinitely, and we have proved that we can get along with very little meat. We can get by with fewer shoes and cuffless trousers, and we gladly blister our hands to till the soil in Victory gardens. Yes; we can undergo almost any form of discomfort and inconvenience. But we could not survive a prolonged famine in liquid fuels. Our domestic economy, our Army, and our Navy are dependent on liquid fuels. To insure continued success in the prosecution of a long war and in the maintenance of a strong Nation thereafter, we must acquire the "know how" on synthetic liquid fuels.

Senator O'MAHONEY. I neglected to call attention at the outset to the fact that this is a joint committee hearing, being conducted by a subcommittee of the Committee on Mines and Mining of the House of Representatives, as well as a subcommittee of the Senate Committee on Public Lands and Surveys. The House committee is operating under the chairmanship of the distinguished Member of the House on my left, the Honorable Jennings Randolph, of West Virginia. It was appointed early in 1942 and has been conducting hearings upon the production of gasoline, fuel oils, plastics, rubber, and other materials from coal and other products.

We are very happy to have Congressman Randolph here this morning, and, of course, he will participate in the hearings.

Are there any questions by the members of the committee?

Senator GURNEY. I have one question.

Senator O'MAHONEY. Senator Gurney.

Senator GURNEY. Mr. Secretary, of course, our national defense is built around our natural resources. Probably our best defense material is the crude oil in the ground. Is that not so?

Secretary ICKES. I would think so. We simply would not be fighting a war today if it had not been for our oil reserves.

Senator GURNEY. And it is the most quickly available in crude oil form?

Secretary ICKES. Yes.

Senator GURNEY. Therefore, it behooves the Nation to remember that our best defense in years to come is to have some of that crude oil left in the ground. I think that naturally follows, don't you?

Secretary ICKES. I hope we have it, sir. Our oil policy has not always been as wise as it might have been.

Senator GURNEY. Anything we can do to substitute other fuels for our present motor fuels made out of crude oil would be certainly in the national interest.

Secretary ICKES. Yes, sir; if we know how to use them. We do not yet. That is the reason we hope that the Congress will adopt the policy and appropriate the money that will make it possible to perfect the known processes and develop others.

Senator GURNEY. Of course, we do not as a committee, and I am sure you do not as the Secretary of the Interior, feel that liquid fuels from coal are the only possible sources of motor fuel. There are other sources, such as alcohol made from farm crops; is that not right?

Secretary ICKES. Yes; alcohol can be used, and we can also make alcohol from petroleum.

Senator GURNEY. That is right, but it is our petroleum that we are trying to conserve.

Secretary ICKES. Yes; we ought to.

Senator GURNEY. And the farm crops are replaceable.

Secretary ICKES. Yes; if the weather is all right.

Senator O'MAHONEY. Any questions, Senator Murdock?

Senator MURDOCK. I have no questions.

Senator O'MAHONEY. Mr. Secretary, you referred to the fact that Germany has been conducting the war on synthetic gasoline.

Secretary ICKES. That is true, largely. It has been getting gasoline from Rumania and a small amount of oil in Poland.

Senator O'MAHONEY. And you also referred to the processes that have been used by Hitler's regime.

Secretary ICKES. Yes.

Senator O'MAHONEY. Referring to them as secret. Do you know whether or not the Alien Property Custodian could, by any chance, give this committee any lead with respect to those processes?

Secretary ICKES. I do not know, but I hope so. I hope he has some.

Senator O'MAHONEY. Of course, he has already taken over a great many enemy-owned plants. I assume most of them probably have been taken out in this country. It might be worth while, don't you think, to check with that office with respect to the German processes?

Secretary ICKES. Do you want us to do it? We would be glad to. Senator O'MAHONEY. I think it would be very helpful.

Senator GURNEY. Mr. Chairman, may I advise you that yesterday the Alien Property Custodian, through Mr. Lee Franklin, requested that he be allowed to send down to us scientific men to tell us about some processes they have, and the secretary of the committee scheduled them for tomorrow, as I understand it.

Senator O'MAHONEY. They are not here today?

Senator GURNEY. No. They will be here tomorrow.

Senator O'MAHONEY. What is the German patent situation, Mr. Secretary—or do you care to testify about that—so far as the production of liquid fuel is concerned?

Secretary ICKES. Well, so far as the German patents are concerned, I assume there must be some within our knowledge and control now. We sent two men to Great Britain to study the processes there. Now, I do not know whether their patents will be made available to us or not. They might be.

As far as we are concerned, as patents are taken out by anyone in the Department of the Interior they are assigned to the Secretary of the Interior and he has the right to license them. We have a number of patents now, and others in the future. They, of course, will be available to the Government without cost, or they may be licensed to private industry if and when private industry becomes interested in these processes.

Senator O'MAHONEY. In other words, if I understand you correctly, it is the policy of the Interior Department that if any of the employees of the Department, who are working in the interdepartment laboratories, discover new processes which they patent they, in turn, assign those patents to the Secretary of the Interior for the benefit of the country?

Secretary ICKES. That is right, and we are very anxious for a policy to be established by the Government which will make it possible to give some special reward to these scientists who make these discoveries and voluntarily and willingly turn them over to the Government.

Senator O'MAHONEY. Is that a new policy?

Secretary ICKES. Comparatively new.

Senator O'MAHONEY. I take it in the past inventors in the employ of the Government have not received any specific compensation for their discoveries and inventions.

Secretary ICKES. They have in some departments. I think the Navy has such a policy. We have a bill pending now which will make it possible for us to reward these scientists who make these discoveries.

Senator O'MAHONEY. You spoke of licensing these patents to private industry. I take it that is an indication of the policy of the Interior Department to encourage private industry; is it not?

Secretary ICKES. That is right.

Senator O'MAHONEY. And it means that this bill is not intended to cause the Government to intervene in this industry for ownership and operation of all hydrogenation processes or all synthetic fuel processes, but merely to lead the way.

Secretary ICKES. That is right. We not only have no power to declare a policy that will encroach on private interests, but we have no desire to.

Senator O'MAHONEY. Are there any questions, Congressman Randolph?

Congressman RANDOLPH. Senator O'Mahoney, may I, for the sake of the record, say that the House subcommittee, to which you have earlier referred, is deeply interested in this subject. We appreciate the courtesy of the Senate in asking us to sit in and participate in these hearings.

I was interested in the observation of Senator Gurney in connection with the necessity of conserving as much as possible the petroleum reserves now in the earth. I think, although it may be departing from your testimony, Mr. Secretary, you have advocated from time to time an increased price on petroleum which would serve as an incentive to bring this petroleum from the earth to the top of the ground.

Secretary ICKES. Yes.

Congressman RANDOLPH. I do not say that there is a difference of viewpoint in your answer to Senator Gurney and your past statements on the subject, but what is your feeling about this increased price for petroleum products?

Secretary ICKES. You expressed it correctly. We have recommended an average increase of 35 cents a barrel on crude, for the purpose of encouraging new discoveries. Of course, so far as preserving our resources is concerned, we do not know that we are truly preserving them, but we cannot use them. My idea would be to discover all that we can and then apply a conservation policy which would make, so far as possible, a large part of what we now know that we have and what we will bring in in the future available for future generations.

Congressman RANDOLPH. And you feel very strongly now that there should be wildcatting?

Secretary ICKES. Oh, yes.

Congressman RANDOLPH. To bring forth the oil that is in the earth.

Secretary ICKES. We have encouraged it by every means in our power.

Congressman RANDOLPH. I should like to ask another question, Mr. Chairman. Is it correct, Mr. Secretary, that it takes approximately 4 gallons of crude oil to produce 1 gallon of 100-octane gasoline which is used by our fighting and bombing planes?

Secretary ICKES. You had better save that question for the technicians. Those processes are changing rapidly. It might have been true yesterday but it would not be true tomorrow.

Congressman RANDOLPH. I will direct that question later, then, to another witness.

Senator O'MAHONEY. Any questions, Congressman Furlong?

Congressman FURLONG. I have nothing to ask, Mr. Chairman.

Senator O'MAHONEY. What is the status now of supplies of drilling materials to wildcatters, with respect to priorities, Mr. Secretary?

Secretary ICKES. Well, we have made the available material go pretty far. We have used second-hand material, and all that sort of thing. We have not been able to get all that we want. There again, Mr. Davies can answer that more in detail, because he is in direct charge of that.

Senator O'MAHONEY. Now, it has been the policy of this committee in previous hearings to invite the experts from other departments who happen to be present to participate in a sort of round-table manner

in the questioning of all witnesses. Secretary Ickes has appeared before us before and he has always welcomed such questions from other witnesses.

We have on the schedule today Mr. Davies, the Deputy Petroleum Administrator, Dr. Sayers, the Director of the Bureau of Mines; Brig. Gen. W. E. R. Covell, of the Quartermaster General's Department; Commodore A. F. Carter, executive officer of the Army-Navy Petroleum Board, Navy Department; Mr. W. Jett Lauck, a representative of the United Mine Workers of America; Mr. William B. Heroy, of the Petroleum Administration for War, and W. E. Wrather, Director of the Geological Survey.

If any of these gentlemen care at this point to suggest any questions, I am sure the Secretary and the committee will be glad to answer them. I don't hear any questions.

Mr. Secretary, we are very grateful to you for your illuminating statement.

Secretary ICKES. Thank you.

Senator O'MAHONEY. Mr. Davies, will you be good enough to come forward?

STATEMENT OF RALPH K. DAVIES, DEPUTY PETROLEUM ADMINISTRATOR FOR WAR

Mr. DAVIES. Mr. Chairman and gentlemen, I suppose that it might be expected in some quarters that, as an oil man with a background of a lifetime in that industry, I would be against the proposed construction of Government plants for the production of synthetic liquid fuels. After all, I have spent my life in the business of producing, refining, and marketing oil as it occurs in the form of natural petroleum, and so it might be reasoned that I would not like to see that kind of oil run into competition with oil that is derived from coal, or shale, or natural gas, or something else.

The fact is, however, that I am not opposed to the proposal. On the contrary, I endorse it, sincerely. Indeed, I might point out that I would favor this enterprise even if I were motivated by purely selfish considerations. After all, there can be no oil business unless there is oil, and that would seem to be sufficient reason for an oil man to want to see that there is every possible assurance of the continued availability of that commodity.

But, beyond any purely selfish considerations, the proposed demonstration plants for production of synthetic fuels have my genuine support for a much more valid and much more important reason: They are definitely in the national interest.

As the Secretary has so convincingly pointed out, our whole national economy is keyed to machinery that is fueled and lubricated with oil, and it would be plunged into the most hopeless kind of chaos if it suddenly were deprived of oil. And, even though it is true enough, as he also pointed out, that nobody expects us to run out of oil in the immediate future, we are using up our oil faster than we are discovering new supplies. Certainly it will be perfectly obvious to everyone that we simply cannot continue to do that unless we are either willing to gamble with catastrophe, or are foresighted enough to prepare against it.

At the present, for many reasons, it would not be feasible for private industry to undertake the experimental and developmental work which the proposed Government plants would do. These experiments will be aimed at evolving processes which may not be used on a large-scale commercial basis for many years. A private company could not justify the tying up of vast sums of its investors' money over so long a period without return. In view of the present ready availability of natural petroleum at low cost, as contrasted with the relatively high cost of producing synthetic oil by presently known methods, the undertaking of this developmental work by the industry would not be economically practicable. I believe that it will be rather generally agreed that the Government needs to lead the way on projects of this kind.

Time, it seems to me, is all-important in this matter. To be sure, it is not expected that synthetic oil will be required to carry on the present war, as far as the United States and its allies are concerned. Indeed, substantial supplies probably could not be produced within the reasonably expected span of hostilities, because the job will very likely require years, not to mention millions of dollars worth of equipment which is now critically scarce.

But, manifestly, we need to look beyond the period of the war, and thus it clearly becomes no more than common prudence to begin now to insure ourselves of a continuing, uninterrupted supply of oil for what we hope will be the long years of peace.

As we look toward these long years of peace, our prospects for a continuing supply of natural crude petroleum are, as the Secretary has said, discouraging. However, if we look at our prospects for coal, oil shale, and natural gas, which are the raw materials for synthetic fuels, the future looks rather satisfactory. It should be satisfactory—that is, provided that we take advantage of these natural resources and follow up our present technical knowledge by developing commercial processes which, without doubt, could lead to the production of practically unlimited supplies of synthetic liquid fuels.

I would think that it would behoove us to be as far along as other nations, even if the need to them is immediate, whereas to us it is only prospective. It seems but elementary foresightedness to keep abreast of developments, for the sake of assuring the stability of our machine economy and to assure that we shall be able to hold our own against others in the years ahead.

In Europe the development of synthetic oil has been dictated by necessity. It has been an essential ingredient of survival. In fact, a substantial—if not a major part—of the fuel employed by our Axis enemies, particularly Germany, for fighter planes, bombers, tanks, trucks, and other ground vehicles, as well as the Diesel fuel for submarines, is the synthetic type made from brown coal.

The Japanese have exploited the oil-shale deposits of Manchukuo and have built plants to produce a substantial part of their liquid-fuel requirements therefrom.

Only the United States, apparently lulled by the delusion that we possessed an infinite supply of petroleum, has neglected to develop synthetic-oil facilities to the stage where they could be utilized when necessary.

Because there are so many uncertainties in the over-all problem of crude-oil production, it is my considered opinion that it would be

undesirable, if not dangerous, to delay this undertaking. It is only good judgment and common sense that we begin now to insure the future with regard to this all-important commodity. If we need some specific example to remind us of the grave dangers that may develop suddenly when a regular supply of a basic commodity is cut off, we need only to think of the problem with which we were confronted when, overnight, we were shut off from our supply of crude rubber. We may, in fact, and probably will, see the time when we must depend in important degree upon imports of crude oil. Let us not experience with crude oil what we have with crude rubber.

The future is uncertain if we do not act with promptness; it is promising if we do. I strongly endorse S. 1243 as an important step toward evolving the knowledge and the facilities for the production of synthetic oil as good, thoroughly justifiable insurance.

I call attention particularly to the Secretary's clear enunciation of the fact that these proposed demonstration plants are experimental projects which are not envisioned as competitive with the petroleum industry. They do not constitute an embarkation by Government into the oil business. In fact, they will constitute, instead, a pioneering venture which should pave the way for private enterprise if the time comes that the national interest requires the intensive development of this new industry.

As an oil man I say that I think this an altogether desirable and a timely development. On the basis proposed it should, in my view, have the hearty support of the oil industry as a measure designed to prepare the way for the advance of an art vital to the future adequacy of our American resources.

Senator O'MAHONEY. Do you know whether the oil industry has done very much work along this line, Mr. Davies?

Mr. DAVIES. A very considerable amount of work, Mr. Chairman largely, however, or almost entirely in the laboratory, which is something different from what is here proposed, the actual construction of demonstration plants.

Senator O'MAHONEY. Do you know whether or not any of the petroleum refineries have developed or taken out patents for the hydrogenation of coal or for the reduction of oil shale?

Mr. DAVIES. The oil industry has a considerable patent interest along these general lines. Now how far it runs to coal in particular I cannot say.

Senator O'MAHONEY. To what extent do you think the Department of the Interior could depend upon the cooperation of the industry in developing new processes under a bill of this kind?

Mr. DAVIES. I think they can expect wholehearted cooperation, Mr. Chairman, from the oil industry. I see no conflict of interests here, in fact the contrary.

It would certainly seem to me that here we have a perfect example of what Government may advantageously do in protection of the national interest, supporting and not conflicting with private enterprise. The concept of Government-industry partnership which has proven so effective in getting a job done in oil in this war, is applicable in this situation. These who are advocating this project are, in my opinion, acting with a practical grasp of the realities and with commendable foresight.

For what it may be worth, I am glad to record my endorsement of the bill, S. 1243.

Senator O'MAHONEY. Congressman Randolph, do you care to ask any questions?

Congressman RANDOLPH. Yes, Mr. Chairman. Mr. Davies, I directed a question to the Secretary in connection with the number of gallons of crude oil necessary for the production of 1 gallon of high-octane gasoline. Would you say to the committee whether that is correct, or approximately correct?

Mr. DAVIES. It depends, of course, upon the type of crude. It varies with the raw commodity, but in general that figure, I would say, is correct. In fact, I recall recently some tests as applied to Arabian crude oil where the figure was just that, 1 to 4.

Congressman RANDOLPH. The reason I asked the question was to bring out the tremendous load that our petroleum is carrying in this air war. We have had many air raids over Germany and occupied Europe, and other sections of the fighting front, where a million gallons of 100-octane gasoline have been consumed. If we break that into crude oil that is 4,000,000 gallons. That is simply one raid. We can see the tremendous depletion of our oil reserves by such type of warfare.

For that reason, under the impact of war, you are here urging the passage of this bill perhaps even more than you would had we not been engaged in that conflict. Is that true?

Mr. DAVIES. That is true. We should certainly have been more impressed with the necessity in the light of the experience we are having today. This military demand is already so great that we could not today supply the unlimited civilian requirements, even if we had the transportation and other facilities necessary to supply it. We would not today, from the production of oil in the United States, have enough to take care of the military requirements and the unrestricted civilian requirements.

Congressman RANDOLPH. Mr. Chairman, I have one final question. Secretary Ickes told the committee that he had recommended 35 cents as an increase in the price of crude oil. How strenuously is the Office of Price Administration, through Mr. Brown, opposing that recommendation?

Mr. DAVIES. Well, I would say quite strenuously.

Senator O'MAHONEY. It is thumbs down, is it not?

Mr. DAVIES. Yes; and as of this date they simply disapprove it.

Congressman RANDOLPH. Is your organization continuing to advocate the raise as strongly as you did a few weeks ago?

Mr. DAVIES. I think I can say we are equally strenuous on our side.

Senator O'MAHONEY. Any questions, Congressman Furlong?

Congressman FURLONG. No questions.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No.

Senator O'MAHONEY. Senator Murdock?

Senator MURDOCK. No questions.

Senator O'MAHONEY. General Covell, do you care to ask any questions?

General COVELL. No.

Senator O'MAHONEY. Any questions, Dr. Sayers?

Dr. SAYERS. No, sir.

Senator O'MAHONEY. Mr. Davies, you remarked, in answer to Congressman Randolph, about the impossibility of meeting civilian demands at the present time. Would you think that one would be justified in saying that the war demands are such that it is clear now that we must depend upon new sources of liquid fuel after the war is over in this country?

Mr. DAVIES. Yes; I think that is clearly demonstrated by the present-day figure.

Senator O'MAHONEY. So if the Eastern States, which are now suffering such hardships by reason of the lack of gasoline and fuel oil, are to be supplied, and if American industry is to be put back on the gasoline motor, it is, in your judgment, absolutely essential that work of this kind be done?

Mr. DAVIES. Well, as regards production of oil from coal by hydrogenation, I think you have a very long-range program, but as a long-range program I think it is a thoroughly necessary one.

Senator O'MAHONEY. What do you mean by that?

Mr. DAVIES. That the hydrogenation of coal I think will not be the answer to the supply of civilian requirements immediately after the war. I think it is a longer-range thing than that. To supply the oil requirement post-war, immediately post-war, at least, I think we shall still look to petroleum.

Senator O'MAHONEY. Well, if it should turn out that the war in the Pacific will extend long after the war in Europe, as some strategists seem now to think is likely, would that not mean that we would continue to use, for war purposes, huge quantities of petroleum by the Navy, the Army, and Air Force?

Mr. DAVIES. It would certainly mean that.

Senator O'MAHONEY. And until we succeed in driving the Japs out of the Dutch East Indies and in making available to our forces in the East the oil supplies in that area, we would still be dependent largely on American supplies of petroleum, would we not, to supply our own forces?

Mr. DAVIES. Well, to what extent we could rely upon foreign crude-oil sources is a question. That is all wrapped up in transportation problems and other problems. Of course, there is a lot of crude oil available in foreign parts. Today it is not drained upon very heavily. Today our allies are pretty fairly dependent upon the production of the United States, or at least the production in the Western Hemisphere.

Senator O'MAHONEY. There isn't to date any question about it, is there? The United States has substantially been supplying the oil that the United Nations have used in prosecuting the war to this point?

Mr. DAVIES. Substantially.

Senator O'MAHONEY. Of course, the conquest of the submarine, or at least the advance that has been made in suppressing submarine warfare has undoubtedly reopened sources of supply outside of the United States itself.

Mr. DAVIES. It is commencing to do so.

Senator O'MAHONEY. But that is another question from the one that I raised, having to do with supplying our own naval forces and our

own air forces in the Pacific. We would still be dependent on United States oil for that, would we not, until we succeeded in reorganizing the oil-producing areas which the Japs now have in their possession?

Mr. DAVIES. Principally United States sources. There is both production and refining equipment in the Persian Gulf, for example, that might be drawn upon to an important extent, but principally we are reliant upon our own United States resources.

Senator O'MAHONEY. And that being the case, it becomes very important to proceed along the lines of this bill?

Mr. DAVIES. I would think clearly so; yes, sir.

Senator O'MAHONEY. Congressman Randolph, do you want to ask another question?

Congressman RANDOLPH. One more; yes, sir. Mr. Davies, returning to the subject of production of crude oil during the present conflict, you have had a wide background of experience in the oil industry. What would you say is the percentage increased cost of drilling now as against 5 years ago in this country?

Mr. DAVIES. Well, I would not want to give an exact figure, because the costs vary so over the country, and vary so as to particular operations. The costs are affected not only by labor and material but by the volumes involved. All sorts of figures have been put together by Government and by industry. There is a good deal of disagreement as to those figures today. It is one of the differences we have in this price matter.

Congressman RANDOLPH. It has shown a decided increase, however, has it not, in an over-all picture?

Mr. DAVIES. That can be said with absolute assurance; yes. Costs have substantially, quite substantially, increased.

Congressman RANDOLPH. What has been the increased price of crude oil in this same period of 5 years?

Mr. DAVIES. I do not have the figures in my mind, but the price is not more today than it was then.

Congressman RANDOLPH. No increase in price but there has been an increase in the cost of drilling?

Mr. DAVIES. That is correct. The margin of profit is very considerably reduced, which is one of the problems confronting us in our effort to speed up development.

Senator GURNEY. Mr. Chairman, I have one or two questions.

Senator O'MAHONEY. Senator Gurney.

Senator GURNEY. Mr. Davies, you are about as close to this petroleum question as anyone in the Government. We have increased our transportation of gasoline and fuel oil to the east coast tremendously by railroad transportation in the last few years. Could you tell me about how many times larger our deliveries are by railroad now than they were, say, 2 years ago? Is it four times or five times?

Mr. DAVIES. Immediately before the war we were moving to the east coast practically nothing by tank car, that being a very expensive method by comparison with tank ship, whereas today that movement amounts to about a million barrels a day.

Senator GURNEY. There was very little oil, I understand, that was delivered by railroad before the war. You are in close touch with it and you know that our deliveries to the east coast are, in a way, regulating the speed with which we prosecute the war. Is that not

correct, that the more oil we get to the east coast the faster the war can be carried on?

Mr. DAVIES. Senator, we have been able to supply the full military needs and the full war-industry needs. We have not been able to supply the full civilian needs. So it is the civilian activity that is curtailed as of today, rather than the war activity. Of course, the civilian and the war activities come together in many ways. I think it can be said that so far we have been able to fully prosecute the war from an oil standpoint.

Senator GURNEY. Do you feel the Army would say, if you delivered another half million barrels a day to the east coast, that they would not take any of it?

Mr. DAVIES. Well, they seem to take about all we can possibly deliver, so I would suspect they would take us up on that kind of proposition, but I think they would tell you, Senator, that they are getting today all that they need.

Senator GURNEY. Well, possibly because they have got to bring up their plans a year or 2 years in advance on the amount of oil they anticipate will be available, but if you can tell them today that you are going to be able to deliver a quarter of a million or a half a million more barrels per day, don't you expect they would take that additional oil and thereby bring about victory a little sooner?

Mr. DAVIES. Well, I would say, Senator, that the bottleneck has not been oil up to the present time; it has rather been transportation, from the war standpoint.

Senator GURNEY. Transportation inside the United States or away from our shores?

Mr. DAVIES. Away from our shores. Had we more ships, we could have moved more oil and have been undoubtedly in a stronger position, from the war standpoint. It has been not lack of oil, but lack of ships so far.

Senator GURNEY. Thank you.

Senator O'MAHONEY. Any questions, Senator Murdock?

Senator MURDOCK. No questions.

Senator O'MAHONEY. We are very grateful to you, Mr. Davies. If there is nothing more you want to add we will excuse you.

Mr. DAVIES. Thank you, Mr. Chairman.

Senator O'MAHONEY. Dr. Sayers.

STATEMENT OF R. R. SAYERS, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Senator O'MAHONEY. For the record, I will introduce you as the head of the Bureau of Mines, Dr. Sayers.

Dr. SAYERS. Thank you, sir.

Senator O'Mahoney and members of the committee, ingenuity and inventiveness and the practical application of new ideas have characterized American industry since the founding of the Nation. By bringing into large scale production the results of scientific discovery and endeavor, American business has benefited the public. It has brought into the home and office and factory and elsewhere in the everyday life of the people hundreds of thousands of materials and

services that sustain life and make our high degree of civilization possible.

Perhaps no industry in the United States in recent years is more typical of such a successful linking of science and civilization than the petroleum industry. We have come to depend upon petroleum and petroleum products for a multitude of things that we do, eat, and wear, and for transporting ourselves and our goods, sheltering ourselves, and fighting our wars. Because oil, in its varied forms, serves so many of our needs and performs so many services the petroleum industry ranks high among the first dozen industrial giants of American enterprise.

But this whole industry, with its tremendous investments in oil wells, refineries, storage tanks, lines, transportation equipment, and its retail outlets spread across the country, is dependent entirely on one thing—oil in the ground.

We have oil now, fortunately, and a half million men are busy getting the crude oil out of the ground, cracking and refining it, and shipping it by truck and railroad and tanker and pipe line, and a quarter of a million filling stations, despite rationing, can go on selling its major products of gasoline and motor oil to truck drivers, bus operators, and motorists all over the Nation.

But as Secretary Ickes has just pointed out, we are not going to have it forever. I think that's why we are here. We cannot consume our oil and have it, too. Some day—and that day apparently is not far distant—we shall begin to run short of this vital commodity. When the time comes, the present turmoil and indignation caused by the mere inconvenience in pleasure travel will fade into insignificance.

Of course, there are those who see no cause for alarm. There are those who say if we don't have oil ourselves, here in Texas, or Oklahoma, or Kansas or Illinois or California, we can always get it from abroad—Russia has lots of oil. So has Iran and Arabia and Venezuela. That is true. Does anyone believe for one moment, however, that our Navy and air forces and motorized services should depend upon other than our own domestic enterprises? I think we learned the fallacy of depending on sources of supply outside our borders in connection with rubber and other materials. A shortage of petroleum in the United States could impair seriously not only our mode of living but even our food supply.

Senator O'MAHONEY. You are saying, Dr. Sayers, as I understand you, that it is unsafe for this country to allow itself to become dependent upon foreign sources of liquid fuel?

Dr. SAYERS. I am. I think it is important that we take steps to insure the future safety of this country and it is by knowing how to provide the essential materials of war that we can do that, and this is one of them. Oil is also an essential material of progress in our type of living. We can live on almost any plane that we can think if we are willing to work for it.

Senator O'MAHONEY. By acting along the lines laid down in this bill, the United States can guarantee itself all necessary supplies of liquid fuel, and free itself from any possible dependencies upon Russia or the British Empire, or any foreign country, the United Nations, or the Axis?

Dr. SAYERS. We can and, of course, I am for that.

Congressman RANDOLPH. May I interpose with a question at the point you are discussing?

Senator O'MAHONEY. Congressman Randolph.

Congressman RANDOLPH. Dr. Sayers, you said one of the considerations of the Hitler machine first rolling into Poland was because that country afforded a production ground for the German forces from the standpoint of synthetic fuels and rubber?

Dr. SAYERS. Synthetic fuels, yes, and possibly rubber. I am not acquainted with the rubber.

We now are engaged in a bitter war. We are fighting an enemy on the continent of Europe who has almost no natural petroleum supply of her own other than what she has captured from one of her vassals. But she still is able to keep in action thousands of tanks, trucks, motorized guns, planes, and submarines. How does she do it? We all know the answer. By synthetic fuels. Give the devil due credit: Germany had the foresight to develop a vast synthetic liquid fuel industry that now enables her to maintain a submarine fleet in the Atlantic and an active air force and motorized army in Russia, Norway, Italy, and in other parts of Europe.

I do not know how large Germany's synthetic fuel industry is. (Our military intelligence undoubtedly has a good indication of its size and location.) I do know that it is big, and would venture a guess that it provides from at least a half to two-thirds of the gasoline, oils, and waxes that the Reich and its satellites are consuming.

Synthetic liquid fuels have been developed to the commercial stage in Germany and England, and in Japan, too, I am informed, because of necessity, because of the lack of natural petroleum within their own borders. We should not wait until our natural petroleum is depleted severely or until a crisis is at hand, before we, too, begin to build an industry. It may be too late then.

I was struck particularly by one passage in the President's radio talk of last Wednesday (July 28) wherein he said:

It is interesting for us to realize that every Flying Fortress that bombed harbor installations at Naples from its base in north Africa, required 1,110 gallons of gasoline for each single mission. * * *

On the basis of these vivid figures, I calculated that a flight of 1,000 bombers every night for a month over Hamburg and Berlin consumes a quantity of gasoline equivalent to complete stoppage for a day of every one of the 30,000,000 or so automobiles, busses, and trucks in the United States.

It is only by such comparisons that I am able to realize the tremendous quantities of petroleum required for our military needs alone. Our civilian needs in the post-war world will be equally as great. I think we all can foresee a development in commercial and private aviation and in other forms of rapid transportation such as the world never has witnessed. You have only to leaf through the pages of any popular magazine these days to see illustrated the home of the future with a new streamlined automobile in the garage, a helicopter in the back yard, and an airport in the distance crowded with commercial and private airplanes of all sizes and descriptions. This, to me, symbolizes American faith in the perpetuation of the gasoline age.

Senate bill S. 1243 is a measure to bolster that faith, to design a structure which will give that faith a basis of reality. It provides authorization for the Government to undertake the construction and experimental operation of demonstration plants for the production of petroleum products, such as gasoline, Diesel oil, fuel oil, lubricants, and waxes from coal, lignite, oil shale and other materials, so that private industry may be in a position to produce the commodities which the public has deemed essential.

It is imperative that such work be undertaken as soon as possible. The Germans needed from 1913 to 1926 to put the first commercial-scale plant in operation to convert coal to oil.

Senator O'MAHONEY. May I interrupt, Dr. Sayers, to ask you what, in your opinion, would be the effect upon aviation development in this country and the maintenance of the world leadership which American aviation now possesses, if we should run short of supplies of liquid fuel domestically available?

Dr. SAYERS. As I stated a little bit ago, any of the inconvenience we have suffered up to the present time would seem extremely insignificant; to me it would be disastrous. I think it would be disastrous to the Nation.

Senator O'MAHONEY. We could not maintain leadership in this new world in the air?

Dr. SAYERS. We could not.

Congressman FURLONG. Dr. Sayers, how many years, starting from scratch, did it take Germany to come to the point which they have accomplished in supplying the submarines, the air forces, and all motor transport and all motor vehicles with this synthetic gas?

Dr. SAYERS. As I stated, from 1913 to 1926 to get in their first commercial installation. They were prepared, by stock-piling and with their synthetic fuel, to start their war.

As I stated earlier, they are probably producing one-half their needs now. That is much less, of course, than anything that we are using. Before the war—I was looking up the figures—they were producing about 25 million gallons of synthetic fuel annually. Doubtless that has been increased a great deal during the wartime. We have good reason to believe that.

Congressman FURLONG. Do you think that we could equal that record?

Dr. SAYERS. I think we can improve upon it.

Congressman FURLONG. We can beat that record?

Dr. SAYERS. I think we can.

Congressman FURLONG. Will we beat it?

Dr. SAYERS. No; we will not, unless we take definite steps to do something along the line suggested in Senator O'Mahoney's bill, and we believe we should go out and meet our problems rather than wait until we have too little time left to solve them.

As I stated, we should not wait until we are severely handicapped by the lack of natural petroleum or until the crisis arrives before we undertake the work proposed by the bill.

Congressman RANDOLPH. Dr. Sayers, may I interrupt at that point to supplement what Senator O'Mahoney has said in connection with the development of aviation after the war? Recently I read a statement of Charles I. Stanton, the Administrator of the Civil Aeronautics

Administration, in which he said there were approximately 25,000 private airplanes in operation at the time we entered the war. He estimates that within 2 or 3 years after the conclusion of this conflict, with a reasonable period for readjustment, there would be at least 300,000 privately operated aircraft in this country. I think it bears out what Senator O'Mahoney has said, and what you, yourself, have said, that of course being only one phase of the over-all picture of aviation of tomorrow.

Senator MURDOCK. Mr. Chairman, may I ask this question?

Senator O'MAHONEY. Certainly, Senator Murdock.

Senator MURDOCK. Dr. Sayers, I assume that between 1913 and 1926, during what I assume you refer to as the experimental stage in Germany in the production of synthetic fuels, that the Bureau of Mines was keeping closely in touch with the work being done in Germany.

Dr. SAYERS. A good deal of it was during the war period. We knew something of it.

Senator MURDOCK. The Bureau of Mines, I assume, did keep in as close contact and touch with the work being done in Germany as you possibly could?

Dr. SAYERS. Yes; as we could under practical circumstances. Dr. Fieldner, who will testify later, can answer that more accurately than I. We did keep in contact, but that contact was not sufficient, and is not sufficient yet, as you can readily understand.

Senator MURDOCK. Is not sufficient for what?

Dr. SAYERS. For us to know all the details that we need to know to put an industry of this kind into a going industry.

We need certain information that we do not have today to build a plant that is a 1943 plant. We have no information of the progress made since 1939. We need to keep in advance of all other nations, and I think we can.

Senator MURDOCK. May I ask this question: How do the raw materials of Germany, from which they produce the synthetic fuels that you spoke about, compare, if you know, with the raw materials available here in the United States?

Dr. SAYERS. Many of them are similar to those that can be obtained in the United States. Some of ours may be superior, but they are of a similar nature. Dr. Fieldner probably can answer that question better than I can.

Senator MURDOCK. It is true, is it not, Dr. Sayers, that back in 1926 and prior to that time, the Bureau of Mines was intensely interested in this very study?

Dr. SAYERS. That is true, Senator.

Senator MURDOCK. Now, do you know the reason why that interest languished, or why that stopped, or just what happened to it?

Dr. SAYERS. Yes; and these are given a little later in my statement.

Senator MURDOCK. I do not want to anticipate anything in your statement, but due to other statements that have been made at previous hearings along this same line, it is my purpose, with the permission of the chairman, to find out, if I can, just why, when we were so interested years and years ago in what, in my opinion, is such a vital question, yet for some reason or other we became apathetic and indifferent and ceased our activities along this line.

Dr. SAYERS. If I may go ahead and come to that later?

Senator MURDOCK. Yes.

Dr. SAYERS. I will come to that in just a moment.

Senator MURDOCK. Yes.

Dr. SAYERS. At the same time, with the knowledge that has been accumulated in this country and foreign countries, this period of time, that is 1913 to 1926, can be reduced to a few years. At the same time, however, all of these processes are in relatively early stages of development and the chances are excellent for great changes and improvements which will reduce materially the cost of the product, the amount of material used in the construction of the plants, and simplify their engineering design.

If the first commercial plants of private industry in the country are to be of the most modern design and of greatest economy and efficiency, it is necessary that the demonstration plants and the research work to be done in them be started well before a crisis in petroleum actually comes upon us.

The Bureau of Mines believes it would be desirable to have private industry undertake the construction and operation of synthetic-fuel plants on its own initiative. The country cannot, however, logically expect private enterprise to carry out the necessary investigations of the processes sufficiently in advance of the time at which they would actually be needed.

Senator O'MAHONEY. Do you use the phrase "commercial plant"?

Dr. SAYERS. Those are the ones to be handled by private industry. What we are proposing, and what is proposed in your bill, Senator, is that we have a demonstration plant in which we can learn all the engineering and determine the costs and how to reduce those costs.

Senator O'MAHONEY. You are not using the phrase in the sense of meaning production of liquid fuel for the purpose of peace, but in the sense of producing liquid fuel for whatever purposes there may be, war or peace?

Dr. SAYERS. That is correct, Senator, and for securing the information for use of our industry in order that they could go on and actually produce for the use of the country.

Senator GURNEY. Mr. Chairman, one question on that.

Senator O'MAHONEY. Surely.

Senator GURNEY. The cost of producing your petroleum from coal will be regulated to a great extent, will it not, Doctor, by how many valuable byproducts you find?

Dr. SAYERS. That is true, and also it will be regulated by the efficiency that we are able to develop in the plant to a great extent.

Senator GURNEY. That is right.

A great deal of experimental work now and in years past has been on the efficiencies, not only of getting the actual fuel, but obtaining the byproducts?

Dr. SAYERS. That is true.

Senator GURNEY. Finding different uses for them?

Dr. SAYERS. That is true. It all fits in as part of the big over-all problem.

Senator MURDOCK. Mr. Chairman, along the line that Senator Gurney has asked the question, would it surprise you, Dr. Sayers, to know that a former senior investigator for the Bureau of Mines claims that

you have actually produced oil, or I mean synthetic fuel from coals on a commercial scale? I refer to the work of the senior investigator for the Bureau of Mines, L. C. Karrick.

Dr. SAYERS. I am well acquainted with his work.

Senator MURDOCK. Here is his statement. It is on page 767 of part I of our hearings.

Senator O'MAHONEY. Give the date, Senator.

Senator MURDOCK. It was at the hearings at Salt Lake City. I think the hearings that are referred to are in July 1941, Salt Lake City.

Senator O'MAHONEY. I asked you to give that date, Senator, so that it would be clear that this committee was working on synthetic fuel more than 2 years ago.

Senator MURDOCK. Yes. I want to commend the distinguished chairman of the committee for the very splendid work that he has done.

This is the statement of Mr. Karrick, and, of course, I think Mr. Karrick will again appear at the Salt Lake City hearings, and I would like to get at the truth of some of his statements, if there is any truth in them.

There is a wrong idea generally prevalent that our work was never carried to a commercial scale, and therefore there is a gap in our investigation as to the commercial possibilities. We refined the shale oils into all petroleum products and sent large quantities to a number of the oil companies of the United States, all of which data are public. One commercial scale single-unit plant was shipped to the United States from Scotland and was operated for 2 years in western Colorado.

Now, he has particular reference there to oil shales, but I think he makes the same contention with reference to coal.

Dr. SAYERS. I would not have expected it in reference to coal. We are well acquainted, of course, with that work. I make a slight reference to that work later in my statement.

Senator O'MAHONEY. It may be that this photograph, which appears on the exhibit of the United States Bureau of Mines, entitled "Bureau of Mines Experimental Shale Plant, Rocky Mountains, 1926," refers to this very experiment, does it not?

Dr. SAYERS. That is correct.

Senator MURDOCK. I might say, sir, that Mr. Karrick, in his statement in Salt Lake City, ascribes the stopping of this program to politics. However, he was rather indefinite as to just what type of politics. He also claimed, if you are familiar with his testimony, that certain work that he had done in the production of synthetic fuels had been suppressed by the Bureau of Mines, and that you had failed to publish it.

I think, by all means, in the present hearings, we should clear up that point, if it can be cleared up.

Dr. SAYERS. I think probably it would be well to clear it up with him present; don't you think so, Senator?

Senator MURDOCK. I think so, too. The only reason I bring it up now is because I was not sure Dr. Fieldner and others of the Bureau of Mines will be at the Salt Lake hearing.

Dr. SAYERS. We will be, Senator.

Senator MURDOCK. I think that probably is the best place to clear it up.

Dr. SAYERS. Gasoline from coal, lignite, or oil shale, so far as can be seen at the present time, will cost more than that obtained from petroleum. No single company is in a position to risk the money in this development unless the time of actual sale of the products at a profit is reasonably near from the inventors' viewpoint.

Because of the huge stake which the public has in this matter, it is up to the Government to undertake the development work—to perfect the known processes, to design and establish new processes, to work out the engineering details, and otherwise as well to demonstrate satisfactorily the practical worth of synthetic fuel production so that industry would be willing to take reasonable risks.

The Bureau of Mines is equipped to undertake this public trust. It has the technologic experts and the research experience in this field. Its scientific investigations into the manufacture of liquid fuels from domestic sources other than petroleum dates back almost 20 years. In 1926, studies were made of one of the processes for obtaining oil from other than petroleum. The results of work on oil shale showed that feasible processes could be developed, but the discovery of large new pools of petroleum led many people to believe that petroleum reserves were inexhaustible.

Since the Bureau ceased work in this field advances in oil refining, cracking, and hydrogenation, development of new methods of extracting oil from shale, and mining shale have been extensive and important. Investigation should be resumed as quickly as possible to determine on a plant scale the best method for applying these advances to the preparation of gasoline and oil from shale and to the development of the cheapest and most efficient processes.

Senator MURDOCK. May I interrupt you there again?

Dr. SAYERS. Certainly.

Senator MURDOCK. The same gentleman, Mr. Karrick, took the position at our former hearing that in certain parts of the United States it is cheaper today to produce oil or synthetic fuels from coal and shale than it is to produce them from oil.

Dr. SAYERS. I regret our data does not substantiate those statements.

Senator MURDOCK. I just wanted to call it to your attention.

Dr. SAYERS. The Bureau's work on the hydrogenation of coal—that is, the liquefaction of coal by the addition of hydrogen under pressure and heat—dates back to 1936.

It has shown, on a laboratory scale, that many American and Alaskan coals are excellent raw materials for the processes and that they will yield high quality fuel oil, motor gasoline, and aviation gasoline. The work has also developed low-pressure and relatively cheaper processes especially adapted to the production of fuel oil. All of this investigation has been on a small-laboratory scale. It is now necessary to expand the whole investigation, to support it with adequate funds to permit development of the best engineering design for the erection of commercial-sized plants for demonstration purposes.

The Bureau carried out a brief study in 1929 of certain catalysts for the synthesis of oil by another method. This work was discontinued for want of funds until 1942 when testing was again resumed on a laboratory scale. Coal, lignite, natural gas, or in fact any fuel that can be converted into the gases, carbon monoxide, and hydrogen,

give by this method gasoline, Diesel oil, fuel oil, lubricating oil, and waxes. The process makes an especially good Diesel oil. It offers great possibilities not only with respect to modifications which will lower the cost of synthetic liquid-fuel production, but also as a source of raw materials for a great variety of chemical products, such as waxes, fats, synthetic rubber, and plastics. It is of such fundamental importance in the oil and chemical fields that the country should exert every effort not only to overtake foreign developments, but to surpass them.

The Bureau's relatively short study of the processes I have just mentioned indicates that we may be able to make major engineering modifications which will greatly reduce the plant size and operating costs.

Technical experts of the Bureau of Mines, and undoubtedly others invited by the committee to testify, who will follow me, will present in detail the nature of the various known processes for the production of liquid fuels from sources other than petroleum.

We have also learned quite a bit from our British friends across the sea, and from American companies and research organizations that have made their data available to us. Such information is very valuable, and the Bureau of Mines is grateful for this cooperation.

It is because of this knowledge and the technologic skill and experience of our scientists that the Bureau of Mines feels confident that it can develop successful methods for making gasoline and oil by various processes from coal, lignite, oil shale and other materials. It can build and operate plants of sufficient size to enable it to obtain all the engineering design and cost data necessary for the erection of large-scale commercial plants when they are needed. Its program, if approved by the Congress, will be coupled with research and development work that will advance present processes well beyond their current state. The effort that will be required to carry out this program will be relatively small as measured against the needs of the country for assured supplies of liquid fuels.

Our petroleum industry now represents investments and assets of about \$15,000,000,000, exclusive of the valuation of recently constructed plants for the production of materials for synthetic rubber. This huge, progressive industry has spent for existing refineries and processing plants alone approximately one-fourth of that total.

It is reasonable to expect that eventually, as our petroleum resources continue to diminish, there will arise a synthetic-fuel industry of equal or perhaps even greater magnitude. American business, with reasonable assurance of economic return, is, as I have stated before, enterprising and quicker than that of any other nation in developing to the maximum the potentialities of any new industry. It would take only a fraction—far less than 1 percent—of the current investments and assets of the petroleum industry in the United States, or about thirty to forty million dollars to demonstrate the practicability of synthetic-fuel production.

It will, of course, be up to the Congress to determine how much shall be expended by the public to build the foundations of this great industry of the future. When the time comes to engage in the actual construction and operation of the demonstration plants, the Bureau of Mines will again come to the Congress and present all the facts

in its possession so that the proper decisions may be made. It is the policy of the Department of the Interior, repeatedly enunciated by Secretary Ickes, to report to the Congress, to consult with it and to seek its advice, just as it is doing at present through this committee.

We shall likewise apply for the necessary materials for the construction of the plant through the proper channels of the Government, just as we are doing now with respect to the construction of additions to our laboratories, helium plants, and pilot plants for metallurgical research.

We are of the opinion that the Bureau's faith in scientific progress blended with the considered judgment of Congress will result in broader and brighter prospects for the establishment of a synthetic liquid fuel industry in the United States through this bill.

Senator MURDOCK. Mr. Chairman, may I just make this statement?

Senator O'MAHONEY. Certainly, Senator.

Senator MURDOCK. Due to the questions that I asked of the Director, I want the record to show that I have the utmost confidence in the Bureau of Mines and its present Director, and the very splendid contribution you have made to our war program.

The only reason for my asking these questions is I am sure that you, as the Director of the Bureau of Mines, and other officials of the Bureau, are just as anxious as I am to get these rather conflicting statements ironed out and find out what the facts are.

Dr. SAYERS. That is correct, Senator, and I thank you for your statements. You are correct.

Senator O'MAHONEY. Perhaps it might be proper to remark that Mr. Karrick was not employed in the Bureau of Mines at any time during the period during which Dr. Sayers was the head.

Senator MURDOCK. That is right. I think his work was all prior to the time that Dr. Sayers came in.

Dr. SAYERS. That is correct.

Senator O'MAHONEY. Any questions, Congressman Randolph?

Congressman RANDOLPH. Thank you, Senator.

On page 5, Dr. Sayers, of your testimony, you speak of the huge stake which the public has in this matter and therefore would lay the premise that it is necessary for the Government to take the leadership. I presume, however, that you want the record to show that in advocating the leadership of Federal authority you also say to the committee what I believe Mr. Davies said, in effect, and that was that private industry in both oil and coal have already worked upon this subject, that is, oil shale and coal, have much experience and knowledge which they will make available to the Government in such a program as contemplated under this Senate measure.

Dr. SAYERS. They have already cooperated with us and have shown their willingness to cooperate with us in this work. I think some of those who will come after us will support that viewpoint. We have had excellent cooperation by industry in the work we have carried on up to the present time, and believe that will continue.

Congressman RANDOLPH. The reason I raised the question is because oftentimes we hear the assertion that such a program as synthetic fuels could be undertaken with success in Germany because of the dictator type of government, whereas in the United States, operating as we do, there is floundering and division of authority and we are not able to

proceed as efficiently or as promptly as a nation like Germany. Do you think that is true?

Dr. SAYERS. I think we can go on and develop our program as fast as they could in Germany.

However, in this particular case I think we could not expect industry to make the expenditure—any one company, or any one group of individuals, with the return on the investment being as remote as it would now seem, from the investors' standpoint. I have inserted the phrase in here, from the investor's standpoint, not from the national standpoint. From the national standpoint it is too close to us now.

Senator O'MAHONEY. Are there any other questions, Senator Gurney?

Senator GURNEY. No questions.

Senator O'MAHONEY. We are very grateful to you, Dr. Sayers, for a very excellent statement.

(Dr. Sayers subsequently submitted the following table:)

United States domestic demand for all oils and domestic demand for motor fuel

[In millions of barrels]

Year	Total all oils	Total motor fuel	Year	Total all oils	Total motor fuel
1917.....		56.3	1931.....	903.2	407.8
1918.....	359.4	75.7	1932.....	835.5	377.9
1919.....	374.5	83.2	1933.....	868.5	380.5
1920.....	455.8	102.9	1934.....	920.2	410.3
1921.....	456.8	108.6	1935.....	983.7	434.8
1922.....	530.9	129.1	1936.....	1,092.8	481.6
1923.....	652.4	158.7	1937.....	1,169.7	519.4
1924.....	687.9	187.0	1938.....	1,137.1	523.0
1925.....	727.0	226.3	1939.....	1,231.1	555.5
1926.....	781.1	261.4	1940.....	1,326.6	589.5
1927.....	802.3	299.8	1941.....		
1928.....	860.4	332.0	1942.....		
1929.....	940.1	376.0			
1930.....	926.5	398.4			

¹ Not available for publication.

Source.—Petroleum Economics Division, Bureau of Mines.

Senator O'MAHONEY. General Covell, will you take the stand now?

STATEMENT OF BRIG. GEN. E. R. COVELL, DIRECTOR, FUEL AND LUBRICANTS DIVISION, QUARTERMASTER GENERAL'S OFFICE, UNITED STATES ARMY

Senator O'MAHONEY. Would you be good enough to give the reporter your full name and the assignment upon which you are working?

General COVELL. Brig. Gen. E. R. Covell, director, Fuel and Lubricants Division, Quartermaster General's Office.

Mr. Chairman, I would like to present a very brief statement, which has been checked by the proper War Department authorities to indicate the Army's approval of the legislation now being considered. While, at the present time, there is no indicated shortage of liquid

fuels for military and essential civilian uses, the supply of crude oil in the continental United States is diminishing——

Senator O'MAHONEY. When you use the word "essential" you are introducing a qualification which is a very serious one, from the point of view of most of the civilian population, I think.

General COVELL. That is correct.

Therefore, it is deemed advisable to explore the possibilities of producing synthetic liquid fuels, and to familiarize industry with the operation of such plants so that they may be used in the event of shortage of petroleum supplies.

In modern warfare as we know it today, liquid fuels are absolutely essential. Over half (in north Africa 65 percent) of the tonnage of all supplies for our Army overseas is petroleum products.

Senator O'MAHONEY. Will you repeat that, General?

General COVELL. Over half (in north Africa 65 percent) of the tonnage of all supplies for our Army overseas is petroleum products.

Senator O'MAHONEY. When you speak of tonnage, you are talking in terms of weight, are you not?

General COVELL. That is correct.

Senator O'MAHONEY. Not in terms of space?

General COVELL. Ship tonnage.

In petroleum products, I think it is weight. I am not absolutely certain on that, because the space comes in it, too. I think 40 cubic feet is a ton.

From the viewpoint of over-all strategic considerations, any successful developments along the lines indicated will provide a factor of safety against any unforeseen turn of events in this war and might be absolutely essential in the event we are unfortunate enough to be engaged in another world war in the future.

Now, I am required to say that time has not permitted us to ascertain the views of the Bureau of the Budget concerning the matters which I have discussed, for which reason nothing I have said is to be construed as indicating any commitment concerning the relation of any contemplated legislation to the program of the President.

Senator O'MAHONEY. Are there any questions?

I take it, General; from the brevity of your statement, you do not care, for military reasons, to go into the discussion of the amount of oil that is being used, beyond this very striking statement which you have made.

General COVELL. No, sir. I would like to retreat or retire behind military secrecy on that.

Senator O'MAHONEY. I am prompted to make the comment that this picture of 65 percent of the tonnage to certain armed forces abroad, of petroleum and petroleum products, is in itself, an indication of the tremendous achievement of the Army and Navy in getting the men and oil over there to do the wonderful job which is being done.

Are there any other questions, Senator Murdock?

Senator MURDOCK. No questions.

Senator O'MAHONEY. Thank you, General.

Senator O'MAHONEY. Mr. W. Jett Lauck.

STATEMENT OF W. JETT LAUCK, UNITED MINE WORKERS OF AMERICA

Senator O'MAHONEY. Mr. Lauck, will you state your name for the record?

Mr. LAUCK. My name is W. Jett Lauck. I have a brief statement to make for the United Mine Workers.

Senator O'MAHONEY. You are appearing here for the United Mine Workers of America?

Mr. LAUCK. Of America; yes, sir.

Senator O'MAHONEY. How long have you been associated with that organization?

Mr. LAUCK. About 22 years, I guess.

Senator O'MAHONEY. In what capacity, Mr. Lauck?

Mr. LAUCK. I have been their economist, assistant to Mr. Lewis. If you will permit me, I have a very brief statement and I will just read it.

Senator O'MAHONEY. Thank you.

Mr. LAUCK. Mr. Chairman and members of the committee, at the present time, as representative of the United Mine Workers of America, I am able to make a brief statement only to the committee relative to our attitude upon the legislation which you are now considering.

In other words, I can speak only of our present and future attitude toward its fundamental purposes and its objectives. The reason for this is that we have not as yet had time to study the scientific and technical sections of and reports on the pending bill, but we expect to do so later, as time goes on and the hearings continue.

The United Mine Workers' outstanding record in the coal industry in recent years has been due to its constant insistence upon policies of orderly, effective, and profitable measures of expansion. Through its legislative proposals, the union, with the cooperation of the operators, has within recent years rescued the soft coal industry from a disorderly, unprofitable, and ruinous state of competition, and has now placed it upon a public, controlled, and profitable basis of procedure. Likewise, since the disastrous break-down of monopoly controls in anthracite, the union has sought through measures of cooperation, control, and action, by miners and operators and the State of Pennsylvania, to increase output, employment, and prosperity.

It is for these reasons, fundamentally speaking, that the bill now before us, as sponsored by Senator O'Mahoney, Secretary Ickes, and the United States Bureau of Mines, meets with the instantaneous approval of the mine workers. In other words, it opens new and important fields for the use of coal. This in itself alone means added opportunities for employment.

In a higher sense, however, aside from the war objective of that type of employers—our union also realizes that this bill seeks to add to our national safety and effectiveness, especially in times of war and other emergencies. We are alive to the fact that this is perhaps its highest objective, and one, when properly understood, which will probably bring to the bill support from all groups of our people.

We have not as yet, as I have said, had time to become fully acquainted with the chemical and other scientific formulas upon which the proposed bill is based. We hope, however, to obtain this knowledge from studying the hearings and the reports of the committee as time goes on.

In other words, we welcome this proposed legislation, and shall be pleased to do all within our power to bring its fundamental objectives to a successful culmination.

That is all we have to say at present.

Senator O'MAHONEY. Are there any questions, Congressman Randolph?

Congressman RANDOLPH. Mr. Lauck, what are the numbers, the round figure of men who are directly or indirectly employed in the coal-mining industry of the United States, anthracite, bituminous, sub-bituminous, shale, and so forth?

Mr. LAUCK. It is between 650,000 and 700,000. It is about 550,000 in coal, I should say. Of course, anthracite has been on the downgrade, so to speak, in recent years, and in the last year or two, has been starting to recover, which we hope will be successful.

Before that it had been completely monopolistically controlled and collapsing, due to the competition of oil—not collapsing, that is too strong a word, but being strongly affected by the competition of oil. Its working membership has decreased for a number of years, and it is only recently that through a steady scheme of cooperation, that is, production control and price control, that it has begun to move up.

It will now range to 75,000, I should say. At a liberal estimate, 550,000 to 600,000 altogether.

Congressman RANDOLPH. An over-all employment of 600,000?

Mr. LAUCK. Something like that.

The Union has about 512,000 members.

Congressman RANDOLPH. Is that larger than it was 20 years ago in this country?

Mr. LAUCK. Oh, very much larger.

Congressman RANDOLPH. Could you give us that figure?

Mr. LAUCK. I could not give you figures 20 years ago.

Congressman RANDOLPH. But you can supply that for the record, the increased employment in the coal-mining industry in two decades?

Mr. LAUCK. Yes.

Senator O'MAHONEY. You see in this bill opportunities for more employment for the members of the group for which you speak?

Mr. LAUCK. Oh, undoubtedly. We do not like to be put upon such a pecuniary basis as that, but there is doubtless a great possibility of it.

Senator O'MAHONEY. That was just incidental?

Mr. LAUCK. Yes.

Senator O'MAHONEY. To the larger features of the bill?

Mr. LAUCK. Yes.

Senator O'MAHONEY. Are there any other questions, Senator Gurney?

Senator GURNEY. No.

Senator O'MAHONEY. Senator Murdock?

Senator MURDOCK. No, sir.

Senator O'MAHONEY. Any questions, Secretary Chapman?

Secretary CHAPMAN. No.

Senator O'MAHONEY. Secretary Straus?

Secretary STRAUS. No.

Senator O'MAHONEY. Dr. Sayers?

Dr. SAYERS. No, Senator.

Senator O'MAHONEY. Mr. Lauck, we are very grateful to you.

Mr. LAUCK. Thank you very much. We expect to go along with the committee in its hearings and study it as we go along.

Senator O'MAHONEY. We will be very happy to have the United Mine Workers when we go to Utah, or when we go to Pittsburgh.

Mr. LAUCK. We are planning to be there.

Senator O'MAHONEY. That is very fine. There has just been handed to the chairman a letter, dated yesterday, from the Secretary of the Interior. It is addressed to the chairman of the Committee on Public Lands and Surveys, the Honorable Carl A. Hatch, the Senator from New Mexico, and is the report of the Department of the Interior upon the bill.

I therefore, take this opportunity to read it into the record.

MY DEAR SENATOR HATCH: You have asked my views on the provisions of S. 1243, a bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

I am wholeheartedly in favor of the legislation proposed in the bill. It is high time that the country embarked in earnest upon the program of research and development work necessary to determine the processes and equipment required for the establishment of an industry which can help to supply the continuing needs of the country for liquid fuels which have heretofore been available from the ample but now waning domestic petroleum reserves.

The total demand for liquid fuel in 1941 and 1942 reached about 1.5 billion barrels annually. The rate of discovery of petroleum has decreased sharply since 1937. In the 3 years 1937-39 about 5.4 billion barrels were added to the Nation's proved oil reserves, whereas in the 3 years 1940-42 the increment was only 1.6 billion barrels. In 1942, the new reserves discovered, including extensions and new horizons in old fields, were at a low of 317,000,000 barrels or only about one-fifth of our annual rate of consumption. This failure to find adequate quantities of new oil was not due to lack of prospect drilling, as 3,264 wildcat wells were drilled in 1941 and 3,029 in 1942.

The decline in the rate at which new discoveries are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The ominous implications of the progressive effect of this decline upon the peacetime economy of the post-war years are easily foreseen and can be effectively forestalled by timely action. The answer to the problem clearly lies in the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

It is apparent that this country can no longer delay in embarking upon a synthetic liquid-fuel program. Our study of petroleum reserves and the rate of their depletion indicates clearly that unless we take action, the end of the age of abundant oil is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, the Department of the Interior has been aware of these trends and has initiated the study of means which may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

However, the time has come when we must get out of the test-tube stage into actual production. Past experiments have given us the scientific knowledge

of the basic processes involved but the way must be blazed for American industry to enter this synthetic fuel field, which inevitably will be one of the major industrial developments of the near future.

It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly.

Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up he work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that private enterprise can take up the task of providing synthetic fuels on the scale necessary to safeguard the Nation's future.

The Department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

Sincerely yours,

HAROLD L. ICKES, *Secretary of the Interior.*

Senator GURNEY. Mr. Chairman.

Senator O'MAHONEY. Senator Gurney.

Senator GURNEY. I am under the impression that our consumption of petroleum has increased very rapidly in the past few years. In 1930 I believe it was about 17,000,000,000 gallons.

This 1.5 billion barrels figures out about 63,000,000,000 gallons. I would like to request the Bureau of Mines this afternoon, if they can, to give the amount of gallons we consumed each year, starting as far back as they have records, so we could put it in the record at this point.

I think it would be very helpful to have that information.

Senator O'MAHONEY. Dr. Sayers, will you take care of it?

It may be, you ought to make contact with the P. A. W. also, so that the statement will be the joint statement of the Bureau of Mines and the Petroleum Administration for War.

Dr. SAYERS. I will be glad to do that.

Senator GURNEY. If they could furnish that to us as early as they can in the hearing, so we could have it as a guide, I think it would be very helpful. (See p. 27.)

Senator O'MAHONEY. The committee will now stand in recess until 2:30 this afternoon.

(Whereupon, at 12:10 p. m. the hearing was recessed until 2:30 p. m. of the same day.)

AFTERNOON SESSION

(The subcommittee reconvened at 2:30 p. m.)

Senator O'MAHONEY. The committee will come to order.

In order to meet the convenience of certain witnesses who are being called out of the city, the order of testimony is being changed a little bit. The first witness this afternoon will be Mr. R. P. Russell, executive vice president of the Standard Oil Development Co., 26 Broadway, New York.

Mr. Russell, will you take the stand, please?

**STATEMENT OF ROBERT P. RUSSELL, EXECUTIVE VICE PRESIDENT,
STANDARD OIL DEVELOPMENT CO., NEW YORK, N. Y.**

Mr. RUSSELL. Mr. Chairman and members of the committee:

My name is Robert P. Russell. I am a chemical engineer by profession. For the last 16 years I have served in various capacities in the Standard Oil Co. (New Jersey) research, development, and engineering groups.

From 1927 to 1930 I was manager of the Research and Development Department of the Standard Oil Co. of Louisiana, an associated company. In that capacity I directed research and pilot-plant investigations of the high pressure hydrogenation process. This work was principally directed toward hydrogenation of petroleum fractions. However, some work involving hydrogenation of coal was carried out, and I believe our group of chemists, engineers, and operators produced the first hydrogenated gasoline from coal to be made in this country. This was in 1927, when there was general discussion regarding a possible oil shortage in this country.

For several years I acted as vice president and general manager of the Hydro Engineering & Chemical Co., the staff of which designed and supervised the construction of large commercial plants for the hydrogenation of oil. For the last 6 years I have been executive vice president of Standard Oil Development Co. in charge of the research, development, and engineering staffs of that company. During this period our technical men have carried out a great deal of work on both the hydrogenation and Fischer processes.

I am glad to appear before this committee to answer if I can any technical questions regarding the conversion of coal into liquid fuels. In this same connection, I participated with other members of our technical staff in preparing, a year ago, for the late Mr. W. S. Farish a memorandum outlining the status of the hydrogenation and Fischer processes. This memorandum summarized the raw material and over-all steel requirements, as well as investments and operating costs, for producing motor gasoline from bituminous coal by means of these two processes. This statement was submitted by Mr. Farish to Mr. Randolph's Committee on Mines and Mining of the House of Representatives on July 15, 1942. In the hope that it may be helpful, I should like to leave copies with you for your record. So far as we know, there have been no significant changes in the technical or economical status of either of these two processes since the date of the memorandum.

Senator O'MAHONEY. The memorandum indicates that these two processes are successful processes?

Mr. RUSSELL. Widely used commercially and soundly developed technically.

Senator O'MAHONEY. And beyond the stage of experimentation?

Mr. RUSSELL. Yes, sir.

Since this memorandum is quite technical in character and is lengthy, and since you have a large number of witnesses to be heard, it may be unnecessary for me to take your time to read it.

Senator O'MAHONEY. The memorandum will appear at the conclusion of your testimony.

Mr. RUSSELL. Thank you.

(The memorandum referred to will be found at the conclusion of Mr. Russell's statement.)

Mr. RUSSELL. Nor shall I attempt to go into technical detail concerning the hydrogenation process or the Fischer process, since this morning there has been presented the general details of these processes to you. May I, however, remind you, for the purposes of my discussion, that in addition to the well-developed processes currently applied in the oil industry there are the following recognized techniques for producing petroleum products:

1. Hydrogenation of coal;
2. Hydrogenation of oil;
3. Fischer process as applied to coal;
4. Fischer process as applied to natural gas;
5. Various techniques for conversion of shale oil into petroleum products.

I should also like to emphasize that all these processes are highly developed, both technically and commercially.

Senator O'MAHONEY. Do you discuss price in this paper?

Mr. RUSSELL. Operating costs, yes. I have some charts that I will show in just a moment.

Many plants employing the high pressure coal hydrogenation process have been built abroad, and large quantities of gasoline and other petroleum products have been and are being made by it. Full details concerning this process are available in this country or can be obtained quickly from England. A large number of commercial plants utilizing the Fischer process also have been built abroad, and almost all of the necessary technical information concerning the process is available in this country. All details of the other processes are widely available in the United States.

Senator O'MAHONEY. When you speak of a large number, can you give the committee some indication of how many you mean?

Mr. RUSSELL. I can't recall offhand the exact number. I should say as far as coal hydrogenation is concerned, the number must be in the order of 10 or so in Germany, and 2 in Great Britain. As far as the Fischer process is concerned, my recollection is that there must be somewhere between 5 and 10, although in size the individual plants—

Senator O'MAHONEY (interposing). Well, all told, not more than 25?

Mr. RUSSELL. Somewhere in that order of magnitude; yes.

I have prepared some charts which summarize graphically the high spots of the technical memorandum mentioned a moment ago. With your permission I should like to show these charts to you, one by one, commenting briefly on each.

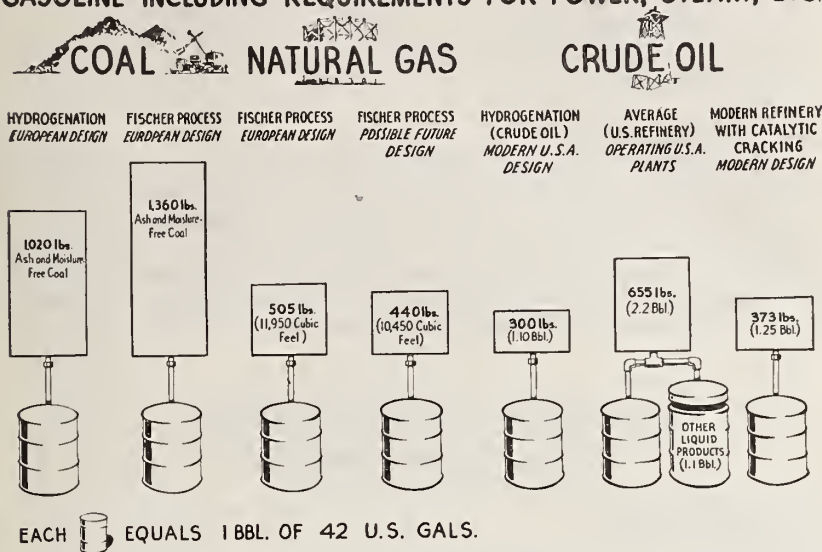
This first chart indicates the total raw materials required to produce one barrel of gasoline by each of these different techniques.

Starting with coal by the high pressure hydrogenation process, it requires roughly 1000 pounds to produce a barrel of gasoline.

Senator O'MAHONEY. Is there any difference with respect to the grade or quality of coal?

CHART No. 1

TOTAL RAW MATERIALS REQUIRED TO PRODUCE ONE BARREL OF GASOLINE INCLUDING REQUIREMENTS FOR POWER, STEAM, ETC.



Mr. RUSSELL. Yes, quite a bit. This was based on a bituminous coal, and these figures are on an ash and moisture free basis, because depending upon the ash content and moisture content, as well as on other characteristics of the coal, the total requirements will vary somewhat.

Senator O'MAHONEY. What difference would it show with semibituminous and lignite?

Mr. RUSSELL. I think I saw some figures over here in the Bureau of Mines chart this morning as to the requirements using lignite. My recollection is—and this is only recollection; I can check it for you—my recollection is, using brown coal such as the Germans use, lignite, their total requirements on a wet basis run up on the order of twice this much.

Starting with the Fischer process, in accordance with present European designs of Fischer process plants, the raw material requirements starting from coal go up to about 1,400 pounds per barrel of gasoline.

Starting with natural gas as the raw material, the raw material requirements by the Fischer process, which can be used to convert natural gas into gasoline, shrink to between 440 and 500 pounds, depending upon whether the present European design is followed or a design which we believe is possible of realization, providing adequate research and development work is carried out.

Starting with hydrogenation of crude, in accordance with present-day designs of hydrogenation plants, the raw material requirements will shrink to about 300 pounds per barrel; and to about 375 pounds per barrel following the most modern oil refining technique. It can be seen that if conservation of raw materials, efficiency of use of the raw materials, was the sole criterion, that it would appear to be preferable to stick with either petroleum or with natural gas before going

into the use of coal as a raw material from which to produce motor gasoline.

In the second chart, I have shown the investments required for plants to produce 300,000 barrels per day of motor gasoline.

Senator O'MAHONEY. Before you proceed with that discussion of investment, are you going to make any comment about the other factors that affect the manufacture of the liquid fuel from various materials?

Mr. RUSSELL. Yes, sir.

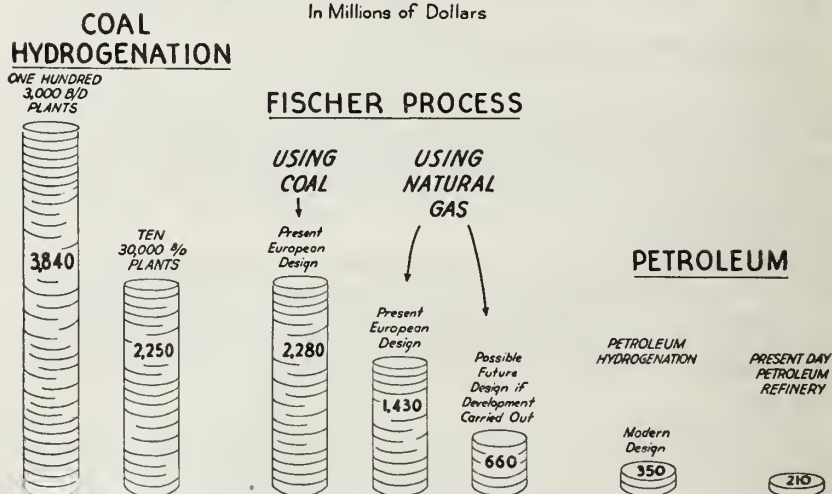
I chose this 300,000-barrel-per-day figure because it corresponds approximately to the carrying capacity of the Big Inch line which, as you know, has just gone into operation, or is about to do so.

Using coal hydrogenation, and basing the figures on very large hydrogenation plants in order to get down to the lowest unit investment cost, it would require the investment of about $2\frac{1}{4}$ billion dollars in plant to produce this 300,000 barrels per day of gasoline.

CHART No. 2

INVESTMENTS FOR PRODUCTION 300,000 B/D GASOLINE

In Millions of Dollars



I would like to stress also that these figures are for the production of motor gasoline, and the investments would go up somewhat if 100 octane were the desired-end product.

Senator O'MAHONEY. Somewhat?

Mr. RUSSELL. Somewhat—not as much as you might think. I mean, the increment cost for going from hydrogenated motor gasoline, such as is made in the plants in England and in Germany, to 100 octane, insofar as investment is concerned, is by no means as great as you might at first glance think.

Utilizing the Fischer process, again starting from coal, the investment involved would be about the same order of magnitude as in building large high pressure hydrogenation plants.

Using natural gas as the raw material, and following present European Fischer process designs, it would run to about one and a half

billion—a billion four hundred million—whereas, with what we believe is sound future design, based on experimental work, we believe it could be done for about 660 million dollars.

These figures should be compared with the investments required in petroleum hydrogenation, namely, about 350 million dollars, or present-day petroleum refineries in the order of 210 million dollars.

Senator O'MAHONEY. Then, as I understand your testimony, to do by the hydrogenation process with respect to petroleum what the refineries are now doing, the investment would be as indicated on the chart? That is to say, it would be almost twice as much for petroleum as the present investment required for the manufacture—

Mr. RUSSELL (interposing). Yes; that is the price in investment dollars that would have to be paid in order to make, say, 100 barrels of gasoline from 100 barrels of crude.

Senator O'MAHONEY. Then it follows that the present method is more efficient, so far as petroleum is concerned, than the hydrogenation process?

Mr. RUSSELL. It is more efficient as regards capital requirement; but as regards the type of product turned out, the situation is somewhat different.

You may remember in that first chart it showed a raw material requirement of only slightly more pounds of petroleum than you received as pounds of finished gasoline as end product; whereas, even with the most modern of present-day widely adopted petroleum refining processes, other byproducts are made as well.

Senator O'MAHONEY. Well, am I to understand that more gasoline can be saved by the hydrogenation process from petroleum than by the present process?

Mr. RUSSELL. Yes, sir. It is possible actually to turn out about 110 barrels of gasoline for every 100 barrels of crude charge following the hydrogenation process, whereas in the present-day oil refineries, the yield of gasoline is about 45 percent, or thereabouts, of gasoline, and the remainder—in other words, products such as fuel oil—

Senator O'MAHONEY (interposing). Then the hydrogenation process applied to present-day supplies of petroleum would increase those supplies, in terms of gasoline, very substantially?

Mr. RUSSELL. Yes, sir.

Senator O'MAHONEY. Is the hydrogenation process used in the manufacture of high-octane gas now?

Mr. RUSSELL. Yes, sir. In fact, the first synthetic aviation gasoline base stock that went into the 100-octane gasoline produced in this country was produced in a large hydrogenation plant which has been operating at Baton Rouge, La., since 1930. For years that was the only source of synthetic aviation base stock for 100-octane gasoline in this country.

Senator GURNEY. Mr. Russell, to make this gasoline out of petroleum, you have a cost there of \$210,000,000 for the plant investment, and about three times that much if you made it out of natural gas?

Mr. RUSSELL. Yes, sir.

Senator GURNEY. And about 11 times as much if you made it out of coal?

Mr. RUSSELL. Yes, sir.

Senator GURNEY. That ratio is about correct?

Mr. RUSSELL. Yes, sir.

Senator GURNEY. Thank you.

Congressman RANDOLPH. Could I at this point follow through on that thought? However, as we think about the increased cost that comes by the use of coal, we also realize that the reserves of coal are to a greater degree so that we cannot even compare them today; isn't that true?

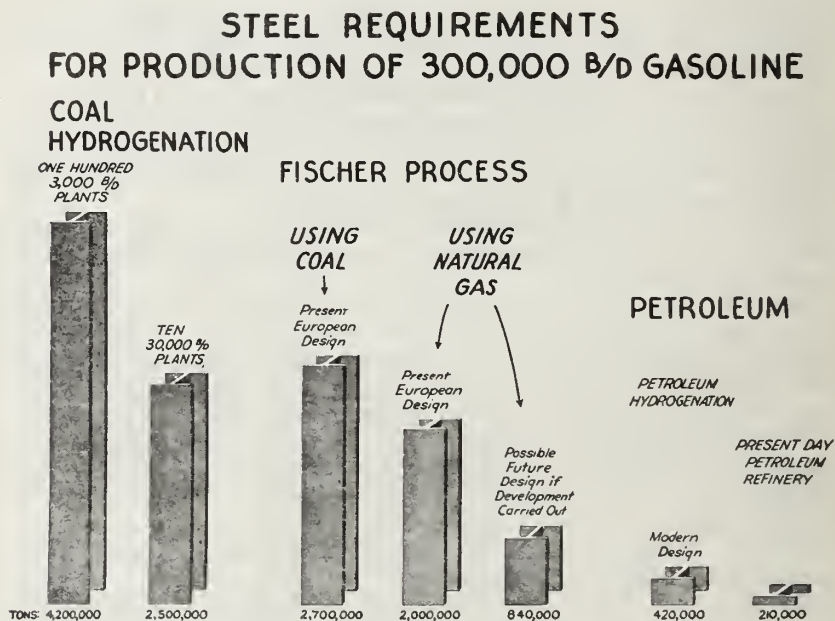
Mr. RUSSELL. Yes, sir.

Congressman RANDOLPH. And that experimental work being carried on, and which would be carried on in the future, would perhaps reduce the cost of the use of coal materially?

Mr. RUSSELL. We believe that the costs involved, both investment-wise and operating cost-wise, in converting coal into gasoline undoubtedly would be reduced as further work is done.

Senator O'MAHONEY. So far as your testimony has gone to this point, you have been discussing only investment cost?

CHART No. 3



Mr. RUSSELL. Yes, sir. I do not think we are as optimistic, however, as a great many people are, as to the magnitude of the reductions in plant cost and operating cost that may be realized. After all, in this field of coal hydrogenation, there has been expended a tremendous number of millions of hours of technical manpower in Germany and in England. There have been a great many man-hours put in over here, too. And after a tremendously intense technical exploitation of that sort, major economies usually result only from very major departures from the techniques previously employed. Those are rather difficult for us to foresee. They may, of course, come about.

Since cost figures, investment costs, such as I just mentioned, oftentimes are less important in periods of great national emergency, far less important than steel requirements involved in building plants,

OPERATING COSTS FOR PRODUCTION 300,000 B/D GASOLINE

COAL
HYDROGENATION
(Coal @ \$2.75 / ton Ash & Moist Free)

**ONE HUNDRED
3,000 % PLANTS**

22.6¢ Per Gal.
TOTAL COST



**TEN
30,000 % PLANTS**

15.9¢ Per Gal.
Not Including
Depreciation

15.5¢ Per Gal.
TOTAL COST

12¢ Per Gal.
Not Including
Depreciation



FISCHER PROCESS

USING COAL
(12.75 / ton)

Present European Design

19.2¢ Per Gal.
TOTAL COST



USING NATURAL GAS
(Gas @ 5¢/1000 CF)

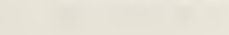
14.7¢ Per Gal.
Not Including
Depreciation



*Present
European Design*

8.8¢ Per Gal.
TOTAL COST

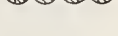
6.0¢ Per Gal.
Not Including
Depreciation



*Possible Future
Design if
Development
Carried Out*

4.8¢ Per Gal.
TOTAL COST

3.6¢ Per Gal.
Not Including
Depreciation

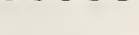


PETROLEUM

**PETROLEUM
HYDROGENATION**
(Crude @ \$1.20
at the well)

3.5¢ TOTAL COST

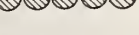
4.8¢
Not Including
Depreciation



**PETROLEUM
REFINERY**
(Crude @ \$1.20
at the well)

3.5¢ TOTAL COST

4.8¢
Not Including
Depreciation



I have shown here [pointing to chart No. 3] the steel requirements for producing this same amount of gasoline. They parallel roughly the dollar figures, although not quite, because there are differences in construction involved which make the steel requirements not quite come in line.

It will be noticed here again that $2\frac{1}{2}$ million tons of steel is involved in coal hydrogenation plants; slightly more involved in Fischer process plants using coal as raw material—that to be compared with what we expect will be realized, something on the order of 840,000 tons of steel using gas as raw material following a modified Fischer process, in comparison with only about a fifth to a tenth as much steel following either present-day petroleum refinery practice or hydrogenation of petroleum fractions.

It is rather interesting also to compare the steel requirements for building the Big Inch line, which as I understand it was about 350,000 tons, again on the order of one-fifth to a tenth of the amount involved based on coal.

Senator O'MAHONEY. Perhaps it would be appropriate to remark here that evidence before this committee indicates that there is an opportunity of expanding materially the amount of steel made in the United States.

Mr. RUSSELL. Also I thought it might be interesting to you gentlemen to touch upon the matter of operating costs.

Senator O'MAHONEY. This is very interesting.

Mr. RUSSELL. These are operating costs [pointing to chart No. 4, see p. 39], which I wish to emphasize are before taxes and without any profit to the manufacturer, with no return on the investment. These are bare operating costs.

In the lower part for each of these operations, the dark-colored pennies indicate the direct costs involved before depreciation is taken. The upper section indicates depreciation on the plant itself, 10-percent depreciation on the process equipment, and 5-percent depreciation on auxiliaries, such as power plant and the like.

In small coal hydrogenation plants, as near as we can calculate it, the product cost is 22.6 cents, nearly 23 cents per gallon, but that would come down sharply to about $15\frac{1}{2}$ cents per gallon if large units were to be constructed.

Using the Fischer process, based on coal, the direct cost is about 15 cents, and total operating cost of about 19 cents per gallon.

This to be compared with a cost of about 9 cents per gallon using natural gas at 5 cents a thousand cubic feet and following present Fischer process plant designs; with the possible future design Fischer process, based on natural gas, it is expected that the total cost per gallon would run slightly under 5 cents, which is to us apparently competitive with the cost of gasoline made by the hydrogenation of petroleum fractions or through present-day petroleum refining technique.

Senator O'MAHONEY. It would seem to be less from the chart.

Mr. RUSSELL. Yes; it is slightly less—4.8 for the Fischer process, future design; 5.5 cents using hydrogenation; and 5.3 cents following present-day petroleum refining practices.

Senator O'MAHONEY. Why should the cost be less with natural gas as the raw material than with petroleum?

Mr. RUSSELL. That is a matter, of course, principally of the cost per unit for raw material charged. These figures are based on crude at \$1.20 at the well, natural gas at 5 cents per 1,000 cubic feet. With cheaper natural gas, this figure would come down somewhat. With more expensive natural gas it would go up. These figures also would fluctuate with changing crude prices.

Senator O'MAHONEY. What sort of coal are you using in this calculation?

Mr. RUSSELL. This was bituminous coal of the same type on which we figured in setting up the steel requirements.

Senator O'MAHONEY. Supposing you were using lignite coal from a strip mine, what would the difference be?

Mr. RUSSELL. I don't have those figures readily available.

Senator O'MAHONEY. I would assume that the cost of mining the coal is one of the principal factors in this calculation?

Mr. RUSSELL. It is a very large factor, but coal handling, and particularly coal drying, would be an offsetting figure; I mean a lower-cost lignite, with a drying cost or washing cost to be added, might offset the lower apparent cost per ton. There is sufficient information to enable us to make up those figures, but we haven't made up any recent ones along those lines.

Congressman RANDOLPH. Mr. Russell, your figures are interesting and informative. They are based entirely upon the Fischer process, which I imagine in the language of a chemical engineer would be the indirect process?

Mr. RUSSELL. Yes.

Congressman RANDOLPH. Would you, for the committee, or could you, or is it proper at this time to give us what the direct process would be?

Mr. RUSSELL. These are the direct process figures here. These coal hydrogenation figures are the direct process figures.

The Fischer process figures constitute the figures for the indirect process. Both operations have been shown on these charts.

Congressman RANDOLPH. They are both shown here?

Mr. RUSSELL. Yes.

Senator O'MAHONEY. Proceed.

Mr. RUSSELL. In this chart [chart No. 5 (shown on the following page)] we have attempted to show the annual U. S. gasoline bill—again I would like to emphasize it is before any taxes and without any profit to the manufacturer—assuming that the 1941 gasoline consumption rate might continue.

Using coal hydrogenation in these more efficient, large plants, the fuel bill would be on the order of slightly under 5 billion dollars a year. It is essentially the same figure for the Fischer process based on coal, as against about $1\frac{1}{4}$ billions using the Fischer process technique as applied to natural gas, and about the same size figure using either petroleum via present-day refining processes or by high-pressure oil hydrogenation.

Senator O'MAHONEY. May I interrupt you to say that in response to a question asked by Senator Gurney this morning, Dr. Sayers has brought to the committee a table showing the domestic demand for all oils and for motor fuels from 1917 to 1942. This table has been inserted in the record on page 27.

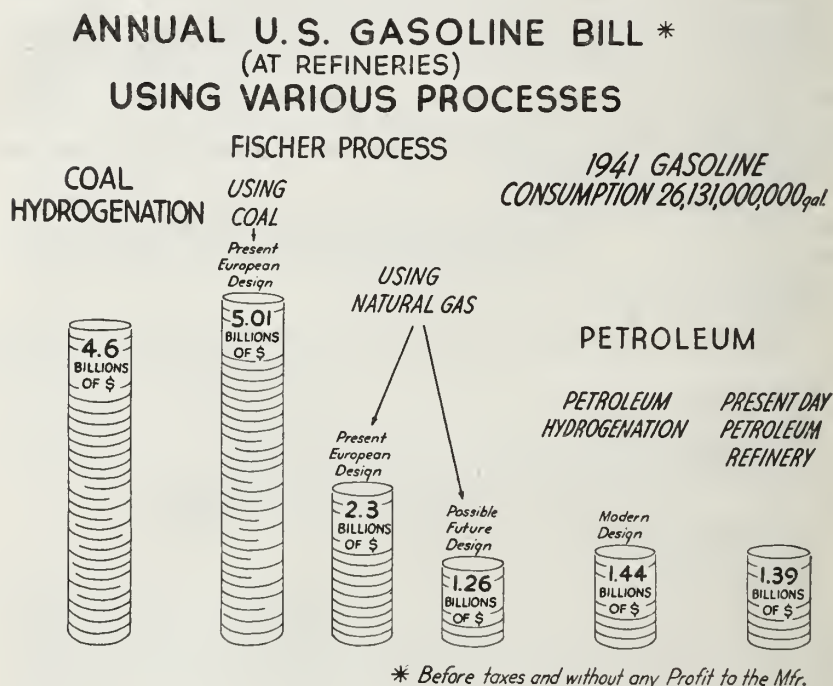
I interrupt you merely to point this out, that according to the table the total of all oil used in the United States in 1930 was 926.5 million barrels. In that same year, 1930, 398.4 million barrels of motor fuel were used. In 1940 the total of all oils had increased to 1,326.6 million barrels, and of motor fuel to 589.5 million barrels. So that there has been a tremendous increase in the use of motor fuel, indicating, of course, the necessity for new supplies of fuel.

Mr. RUSSELL. Yes.

Senator GURNEY. Mr. Russell, there seems to be a little difference here; maybe we can clear it up.

Mr. RUSSELL. I just tried to make a mental calculation. I thought they checked pretty well.

CHART No. 5



Senator GURNEY. They have it separated here into two columns—all oil—

Mr. RUSSELL (interposing). In 1940 the figure was 589.

Senator GURNEY. Yes.

Mr. RUSSELL. Times 42—are those 42-gallon barrels? It comes out very close to this figure.

Senator GURNEY. That is right. "Motor fuel demand in 1940 was 589 million barrels, and $2\frac{1}{2}$ times that, or 2.3 or something like that, for the consumption of all oil. That would be burning oils, domestic and commercial, I expect.

Mr. RUSSELL. Heavy fuel oils.

Senator GURNEY. For railroad use and what-not?

Mr. RUSSELL. Yes.

In the light of the considerations graphically shown in these charts, it has been my own belief that if crude supplies should dwindle to a critical minimum, the next major sources of petroleum products would be natural gas, tar sands, and oil shale.

Before the war, our company had planned aggressive research and development programs in each of these three fields. These programs had to yield to development work more vitally connected with the war. We are now starting to pick up experimental work in these fields so that workable commercial processes can be available when and if the need for them arises.

In closing, I should like to say that our technical people have been happy to turn over to the Bureau of Mines all technical data in our possession concerning coal hydrogenation. Both the oil and coal industries in the United States have great confidence in the technical ability and the sound administrative direction of the Bureau of Mines. Both industries will, in my opinion, be glad to cooperate with the Bureau in any program which could be generally accepted as a proper sphere of Government activity.

Thank you.

Senator O'MAHONEY. What is your opinion with respect to the desirability of legislation of this character?

Mr. RUSSELL. I just haven't had an opportunity to study the bill in question, so I am afraid I am not in position to express an opinion.

Senator O'MAHONEY. Well, without regard to the details of the particular bill, would you care to express an opinion as to whether or not Congress should authorize an agency of the Government to undertake demonstration plants?

Mr. RUSSELL. In answer to that question, I might say that I think our company, and all other companies that maintain their own large technical organizations, would be only too glad to cooperate with any such endeavor to the extent that we could. We have tried to make available to the Bureau and to your committee and to Mr. Randolph's committee last year, all the elements of technical information in our possession which we felt might be a help in permitting you gentlemen to come to some conclusion in answer to a question such as you have just raised.

Senator GURNEY. Of course, your charts showed, Mr. Russell, that you felt the price could be further lowered, the price of producing these units of gasoline, if further experimental work was carried on.

Mr. RUSSELL. Yes.

Senator GURNEY. In other words, you felt that you would get some real results if experimentation was carried on along the right channels?

Mr. RUSSELL. We feel the greatest possibilities along those lines probably rest in the Fischer process for conversion of natural gas, at least we think that the opportunities for such improvement in plant cost and operating cost are greater with the Fischer process based on natural gas, than they are for either the Fischer process starting with coal or for the high pressure hydrogenation process starting with coal, just because there hasn't been the amount of technical endeavor spent in the natural-gas situation.

Senator GURNEY. Tell me if you can, Mr. Russell, a statement was made this morning that we had proven oil reserves sufficient for present-day consumption for another 15 years. Just accepting that

figure as being correct, how much longer would natural-gas reserves give us our petroleum supply? Compare the known reserves of natural gas with the present known reserves of crude oil.

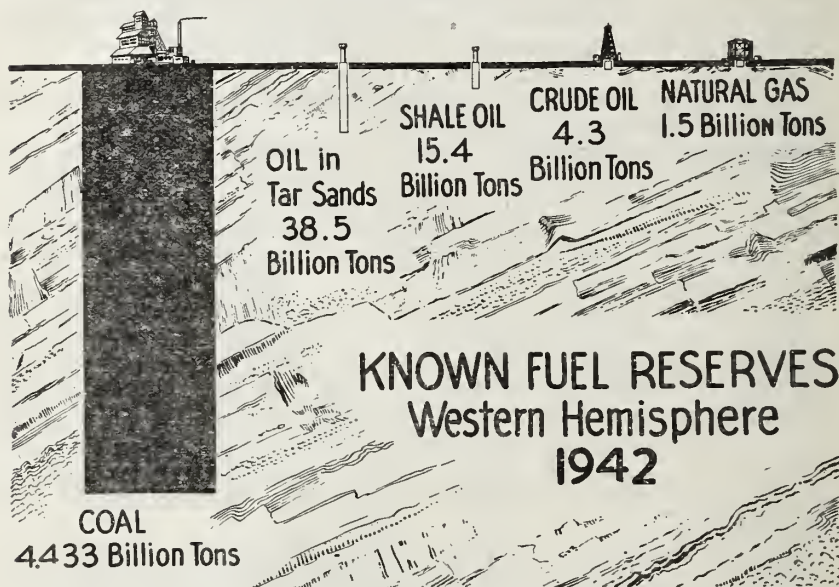
Mr. RUSSELL. I have a chart that bears on that which I didn't show, and which isn't a particularly good one, but I will get it, it won't take but a second.

Preliminary to answering that question, there are shown on this chart (chart No. 6) the known fuel reserves in the Western Hemisphere, in accordance with the figures for 1942.

Senator GURNEY. That takes in South America?

Mr. RUSSELL. Yes; the whole hemisphere, indicating natural gas at $1\frac{1}{2}$ billion tons; crude at about 4.3 billion tons; shale, 15.4; oil in tar sands at about 38.5 billion tons; and coal at this perfectly terrific total of nearly 4,500 billion tons.

CHART No. 6



Senator GURNEY. Well, that is fine for the Western Hemisphere, but in comparing that with a statement of our own United States reserves, I was hoping maybe we could find out what we had in this country rather than taking in the whole continent.

Mr. RUSSELL. I know that in late years—and by late years I think I am talking about the last, probably the last 5 years, although I am sure Dr. Sayers or Dr. Fieldner will have the figures at their finger tips—the discoveries of natural gas in tons per year have been just about equal to the discoveries of crude. By crude discoveries, now, I mean not only new fields but also extensions to existing reserves. So whatever our situation is in this country—I don't happen to have those figures in mind—

Senator GURNEY (interposing). They are available, you think, some place?

Mr. RUSSELL. Yes, indeed; I am sure probably right here with the Bureau of Mines.

Dr. FIELDNER. Our figures in reserves for natural gas and oil?

Mr. RUSSELL. What are they?

Senator O'MAHONEY. While Dr. Fieldner is looking that up, may I ask you if it is possible to make a proper comparison between natural gas and coal in terms of tons?

Mr. RUSSELL. A ton of natural gas—if we are talking now about converting each of those materials into gasoline, for example—then based on the figures shown on the first chart, a ton of natural gas means above five times as many barrels of oil or four times as many, as a ton of coal. So that factor must be taken into consideration.

Senator O'MAHONEY. This chart which you are now discussing shows the reserves of natural gas amounting to 1½ billion tons.

Senator GURNEY. In the Western Hemisphere.

Senator O'MAHONEY. In the Western Hemisphere; whereas, coal amounts to 4,433 billion tons.

Senator RUSSELL. Right.

Senator O'MAHONEY. But the factor of convertibility for gas is much greater than that for coal?

Mr. RUSSELL. Yes.

Senator O'MAHONEY. So that the figures do not represent the correct picture as to the amount of gasoline which could be produced from the two?

Mr. RUSSELL. That is right.

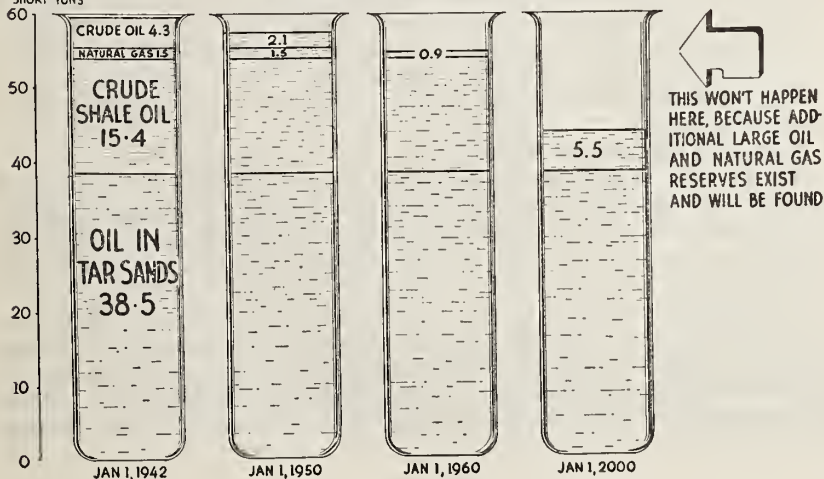
On this chart (chart No. 7) I have taken these figures and, on what I am sure everyone will admit is an entirely erroneous basis, made some extensions into time. It was necessary, of course, to make a number of assumptions, and these assumptions, I feel sure, are inaccurate.

CHART No. 7

WESTERN HEMISPHERE

RESERVES OF CRUDE OIL, NATURAL GAS, OIL IN TAR SANDS
AND CRUDE SHALE OIL

BILLIONS OF
SHORT TONS



The first assumption, that I am sure is wrong, is that there will be no new reserves of oil discovered in this hemisphere. I am just sure that is wrong.

The second assumption that I made was that there would be no increase in consumption of gasoline over, let's say, the next 40 or 50 or 60 years—and I personally don't happen to believe that, either. But perhaps one of those assumptions might tend to offset the other.

Senator O'MAHONEY. Now before you proceed, I think Dr. Fieldner has the answer to your question.

Dr. FIELDNER. I have in my statement a chart in which I have given the estimated reserves of coal, oil, and natural gas, in terms of equivalent tons of bituminous coal of 13,000 B. t. u.'s, that is an average bituminous coal.

Senator O'MAHONEY. Then your chart has a common denominator?

Dr. FIELDNER. It is based on heat units.

Senator O'MAHONEY. But it has a common denominator?

Dr. FIELDNER. On a heat-unit basis.

Senator GURNEY. Is that in the United States?

Dr. FIELDNER. Yes; it is restricted to the United States. And that is, for natural gas, 3.2 billion tons of 13,000 B. t. u. coal; and petroleum $4\frac{1}{2}$ billion tons.

Mr. RUSSELL. In other words, that would be about $4\frac{1}{2}$ percent?

Dr. FIELDNER. Yes; that is right. And of shale oil, 21,000,000,000 tons. Then of lignite, 484,000,000,000 tons; subbituminous coal, 598,000,000,000 tons; and high-volatile bituminous coal, such as we can convert to oil—1,405,000,000,000 tons.

Now, I haven't given the anthracite or low-volatile bituminous coal, which we don't consider suitable for direct hydrogenation, although they might be used by the Fischer-Tropsch process.

Senator O'MAHONEY. May I ask this question: Mr. Russell has been talking in terms of the Fischer process and of hydrogenation in general terms. What process has the Bureau of Mines used at its Pittsburgh plant?

Dr. FIELDNER. These results on that chart were by the direct hydrogenation process, the so-called Bergius process, and not the Fischer.

Senator O'MAHONEY. And you were talking of the Bergius process?

Mr. RUSSELL. I was talking of the Bergius process as it looks after, oh, nearly 30 years of development work.

Dr. FIELDNER. That is right, it is the modified, up-to-date, improved Bergius process.

Senator O'MAHONEY. All right, you may proceed.

Mr. RUSSELL. On the basis of the two assumptions which I mentioned earlier, and which I said I felt personally were both wrong, I tried to jump from 1942 up to the year 2,000, assuming that the easiest materials to convert into gasoline would be those upon which we would work first.

By 1950, we would have gone quite deeply into our petroleum reserves. By 1960, on the basis again of these two erroneous assumptions, plus a third I didn't mention, namely, that you could get the oil out of the ground at this rate—which, as Secretary Ickes pointed out this morning was impossible—we would have dipped into our natural

gas reserves but wouldn't yet have touched our shale oil or the oil in tar sands; but by 2000 we might have conceivably delved quite deeply into the shale and be approaching the time when the tar sands might become important.

Senator O'MAHONEY. And the conclusion which you reach is that in using these raw materials in the order of their availability for reduction cheaply into gasoline, by the year 2000 we still would not have reached the coal?

Mr. RUSSELL. That is right. As I say, I know the assumptions are wrong, and I wouldn't be at all surprised to have situations arise at some time when coal hydrogenation might, for some reason of transportation or otherwise, become desirable in some part of the country and become economically justified.

Senator O'MAHONEY. Now, the first erroneous assumption that you make, I think may be worthy of a little more development. That is that there will be no material discoveries of oil, of crude petroleum, from now on, in the world—that is your assumption, is it not?

Mr. RUSSELL. No; it is confined strictly to the Western Hemisphere.

Senator O'MAHONEY. Now getting this on the basis that Senator Gurney spoke of, do you think that the assumption is wrong so far as the United States is concerned?

Mr. RUSSELL. Yes, sir.

Senator O'MAHONEY. You think there will be new reserves of crude petroleum discovered in the United States?

Mr. RUSSELL. Yes, sir.

Senator O'MAHONEY. Well, why aren't we discovering them?

Mr. RUSSELL. I am not a producer.

Senator O'MAHONEY. But you are an observer, and I think a very competent one. What do you think should be done to produce more reserves of crude petroleum now? The reason we are considering this bill, of course, is because we are acting upon the assumption that the declining curve of discoveries makes it important for the country to turn now, before it is too late, to the development of other sources of liquid fuel.

Mr. RUSSELL. Well, I am really not competent to give any authoritative answer to that question.

Senator O'MAHONEY. But you were competent enough to tell this committee that you believed the assumption —

Mr. RUSSELL. (Interposing). My personal belief.

Senator O'MAHONEY. Yes; your personal belief is that to assume that the discoveries of oil in the United States will not continue is a mistaken assumption. Now what do you base that on?

Mr. RUSSELL. A number of years ago I happened to write a book, with R. T. Haslam, that was called *Fuels and Their Combustion*. This is not an ad for the book —

Senator O'MAHONEY. (interposing). Well, I will make a plug out of it, Mr. Russell, for you.

Mr. RUSSELL. One of the things that impressed us a great deal in getting together the information on oil reserves at that time, was to make a plot of the known reserves of petroleum, year by year, beginning in the early 1903's, as against the production, year by year; and we found that the two curves paralleled each other very closely.

And it was quite evident that taking the known reserves, let's say in 1916, by a very short time later there had been produced more oil than the known reserves were just a few years previous.

Those figures came along very, very nicely, and I can't for the life of me believe that discoveries in this hemisphere or in this country are by any means over.

Senator O'MAHONEY. When did you publish your book?

Mr. RUSSELL. 1926.

Senator O'MAHONEY. You should have been present at our hearings last year, and you would have seen that those curves have diverged.

Mr. RUSSELL. Have begun to diverge; yes, sir.

Senator O'MAHONEY. Well, thank you very much, sir.

Are there any other questions?

Senator GURNEY. I would like to get in the record a little better explanation of that last chart there, which is very illuminating to me, and I think to all of us.

Of course, it has been said that by the year 2,000, taking these figures that you say are erroneous, but still the best we can use at the present time, by the year 2000 you will not have used up crude from shale oil and oil from tar sands, and will not yet have reached the stage where we will have to use coal. That is evident from your chart there, is that right?

Mr. RUSSELL. Looking at the thing as I would have to, being in a large industrial research and development organization, our tendency always would be to go first after the processes that to us appear the easiest to bring to successful conclusion, and hence my statement earlier.

Senator GURNEY. And to bring us motor fuel at the lowest cost per gallon?

Mr. RUSSELL. Yes, sir.

Senator GURNEY. So the chart shows there that our crude oil will be finished, figuring that we won't discover any more crude oil, we will have used that up in about 1955 or sometime between then and 1960; is that right, from the chart?

Mr. RUSSELL. I tried to make clear that I was sure that the—that is what the chart would say, yes—but the basis, I would like again to emphasize, is entirely wrong.

Senator O'MAHONEY. That is what the chart says, but not what the witness says.

Senator GURNEY. I am trying to get on the record here what the chart says, and we are assuming that no new fields will be discovered, and basing it on that assumption the chart says we will be out of crude oil before 1960; that is right, isn't it?

Mr. RUSSELL. That is right.

Senator GURNEY. And then from 1960, say for 5 years, we will be using gasoline made from natural gas, and then that will be gone—is that right?

Mr. RUSSELL. Yes.

Senator GURNEY. Then we will start in on the crude from shale oil?

Mr. RUSSELL. Yes.

Senator GURNEY. Now what is shale oil, I would like to find out where that is located in this country? Is that Colorado oil shales?

Mr. RUSSELL. There are shale deposits—some of the Bureau of Mines statements here, I think, indicate pretty clearly where the richest shales are located, and our natural supposition has been that the first shales to be worked on would be those most readily accessible from the mining standpoint, and those which in addition were very rich, so that the minimum investments in steel and operating cost would be required to make the necessary product.

Senator GURNEY. Well, I don't think—

Mr. RUSSELL (interposing). I haven't attempted to follow, myself, the location of the richest shale deposits, so I can't speak with authority.

Senator GURNEY. Well, it will be similar to the oil shale of Colorado?

Mr. RUSSELL. Yes.

Senator GURNEY. All right.

Now, if I can just conclude there, because we have not gotten down into the tar sands yet, and probably in the year 2000 is about as long as any of us in the room will live, so maybe we hadn't ought to think any farther than that at the moment—but comparing the cost of production, if you could, gasoline now in the field costs us around 6 cents a gallon, say, made from crude—what will it cost from natural gas?

Mr. RUSSELL. About the same, or slightly less.

Senator GURNEY. And how much per gallon from shale oil?

Mr. RUSSELL. I am sorry that I don't have figures that I would be willing to release as authoritative on that at this time. We have made numerous estimates, but we don't like to put them out until we have had a chance to really firm them up.

Senator GURNEY. Could we estimate a cost of 10 cents a gallon?

Mr. RUSSELL. I would much prefer not to guess. We like to really estimate them.

Senator GURNEY. Can we get it within a nickel, then?

Mr. RUSSELL. I have some reasonably strong convictions as to what the processing cost is going to be after the shale is received at a refinery site, but what the mining costs would be, I just frankly don't have.

Senator GURNEY. Well, let's say we had a stock pile at a refinery, then, how much would it cost per gallon?

Mr. RUSSELL. It would be on the order of the 10-cent figure that you mentioned, maybe somewhat more or less. We just do not have firm figures.

Senator GURNEY. Then as I see it, the country can look forward to getting its gasoline up to the year 2000 at a refinery cost of under 10 or 12 cents a gallon?

Mr. RUSSELL. I should think that would be a reasonable assumption.

Senator GURNEY. If we don't have inflation.

Mr. RUSSELL. I would just like to make one additional point. In this chart I showed shale oil being utilized prior to application of any of these techniques to tar sands. I am not at all sure that the two won't come along side by side. We just don't have a firm enough picture as to investment costs, steel requirements and processing costs, to be able to say with assurance which would be used first, or to the greatest extent.

Senator O'MAHONEY. Now if we should make another assumption, namely, that the progress of aviation would accelerate greatly the consumption of motor fuel, what difference would that make in your chart?

Mr. RUSSELL. I suppose it would tend to speed up the day in which these other materials would have to be brought into play.

Senator O'MAHONEY. These figures which were brought here by the Bureau of Mines show, for example, that in the 4 years between 1936 and 1940, there was an increase of more than 100,000,000 barrels of motor fuel used in the country, and I think it may be reasonable to assume that that rate of increment is much more likely to obtain in the future with the development of aviation, than that the use should be stabilized upon the 1941 rate of consumption.

Mr. RUSSELL. That may be.

Senator O'MAHONEY. And if that were the case, then this chart would be altogether out of proportion?

Mr. RUSSELL. It already is, sir.

Mr. RANDOLPH. I think, if I may say it kindly, your information to the committee is at variance, of course, with the other witnesses, and I want to get from you whether you actually believe that the United States should consume or deplete all of its oil and gas resources before turning to the use of coal?

Mr. RUSSELL. No, sir; no, sir.

Senator MURDOCK. Where are the tar sands that you referred to?

Mr. RUSSELL. As I recall it, the principal deposits are in Canada.

Senator MURDOCK. In Canada?

Mr. RUSSELL. Yes, sir.

Senator O'MAHONEY. Dr. Fieldner would like to ask you a question with respect to cost.

Dr. FIELDNER. In your cost, you said that included everything except taxes and profit?

Mr. RUSSELL. Yes.

Dr. FIELDNER. Did you mean that it includes amortization of the plant?

Mr. RUSSELL. No, sir; it was depreciation on process equipment at 10 percent per year, and on auxiliary equipment, such as power plant and the like, 5 percent.

Dr. FIELDNER. So you do include amortization?

Mr. RUSSELL. Amortization, yes; but no return on capital.

Dr. FIELDNER. Thank you.

Senator O'MAHONEY. Could you leave those charts here in case we should want to refer to them?

Mr. RUSSELL. I have copies of the first five charts I discussed, which I will be glad to file with the committee.

(The first five charts discussed by Mr. Russell will be found on file with the committee.)

Senator O'MAHONEY. We are very grateful to you, Mr. Russell, for your statement.

Mr. RUSSELL. Thank you.

(The memorandum referred to earlier in Mr. Russell's statement is as follows:)

MANUFACTURE OF GASOLINE AND OIL FROM COAL¹

INTRODUCTION

There are two main processes for converting coal into gasoline and oil. In the first, the hydrogenation process, finely powdered bituminous or lignite coal is mixed with part of the heavy oil made in the process to form a paste, which is pumped into high pressure (3,000 to 7,500 pounds per square inch) forged reaction vessels, in which, through reaction with hydrogen gas at high temperature, the coal is converted into heavy oil. This heavy oil, with additional hydrogen, is pumped into a second set of high pressure, high temperature, reaction vessels in which, with the addition of a catalyst, the heavy oil is converted into gasoline.

In the second process, the Fischer process, the coal is first converted to water gas (a mixture of carbon monoxide and hydrogen), which is then highly purified and pumped into relatively low pressure, but reasonably high temperature, reaction vessels filled with catalyst, in which is formed a mixture of very poor low-octane gasoline and paraffinic kerosene and gas oil. This Fischer process primary gasoline must be further refined to convert it into gasolines high enough in octane number to be suitable for use in modern United States automobile engines.

This memorandum outlines the present status of the hydrogenation and Fischer processes and summarizes the raw material and over-all steel requirements, as well as investments and operating costs for producing motor gasoline from bituminous coal by means of these two processes.

SUMMARY

In the early 1920's the Standard Oil Co. (New Jersey) was very much interested in the possibilities of converting coal into gasoline and other oil products. About 1925, crude oil was high-priced and known reserves of crude in the United States were quite small. These known reserves at the 1925-26 rate of consumption would have only lasted from 5 to 6 years. Hence, it is only natural that the Standard Oil Co. (New Jersey) should have investigated thoroughly any techniques which might tap other large potential sources of oil, and it was well known that coal reserves were adequate for hundreds of years to come. It was known that the Germans had developed a technique for converting oil which was, even at that time, being utilized on a commercial scale. In 1927, Standard acquired the rights for application of the hydrogenation process to petroleum, and in 1929 concluded the arrangements under which the rights were acquired for application of the process for conversion of coal into oil. In view of the possibility that conversion of coal into oil might become necessary in the not too distant future, in addition to its own experimental work on conversion of coal into oil, the Standard Oil Co. (New Jersey) contributed considerable sums of money to coal investigations being carried out by the Carnegie Institute of Technology. During the next few years, tremendous crude oil reserves were discovered in the United States, and, hence, active interest in the hydrogenation process for conversion of coal into oil died down.

High-pressure hydrogenation and the Fischer synthesis have been developed and utilized in large commercial installations abroad for converting bituminous coal into gasoline and oil. The first hydrogenated gasoline produced from coal in the United States is believed to be that made in the experimental units of the Standard Oil Co. of Louisiana in the summer of 1927. Both these processes are now fully demonstrated both technically and commercially. Quite complete technical data on both processes are available in the United States. Certain additional technical data would be required if large coal hydrogenation plants were to be built in the United States and this information could, if desired, be secured readily from England. The data on the Fischer synthesis are quite complete. If large scale plants following the European designs were to be built in this country it would only be necessary to carry out a certain amount of experimental work on catalyst manufacture and testing.

The high-pressure hydrogenation process can be utilized for converting low-grade crudes into higher yields of gasoline than can be obtained from crude by

¹This memorandum was originally submitted on July 15, 1942, to the Subcommittee on Mines and Mining of the House of Representatives by the late W. S. Farish, then president of Standard Oil Co., (New Jersey).

other fully developed processes. The amount of steel required, the investment costs and the cost of the gasoline produced are all much lower for oil hydrogenation than for coal hydrogenation; hence, as crude supplies dwindle, presumably oil hydrogenation would be employed prior to utilization of coal hydrogenation. About 110 barrels of gasoline can be made from 100 barrels of crude through hydrogenation, in comparison with the present average of about 45 barrels, and approximately 80 barrels obtainable through catalytic cracking and polymerization.

The Fischer process can be used for converting natural gas into gasoline and plants for this purpose show much lower steel requirements, investments and gasoline cost than Fischer plants starting from coal. Since natural gas reserves in the United States are so large (tons of new natural-gas reserves approximately equal to tons of new crude reserves), it appears probable that the Fischer synthesis would be used for converting natural gas before coal-based Fischer synthesis units would be built.

Table I shows summarized figures for two available estimates on these processes when converting coal to gasoline. The figures shown for the Fischer operation are based on a plant producing 3,960 barrels per calendar day of gasoline, while the coal hydrogenation plant has an output of 2,950 barrels per calendar day. Figures are also shown in the table for coal requirements, indicating somewhat greater consumption by the Fischer process (0.68 ton per barrel of gasoline versus 0.51 for coal hydrogenation). The gasoline produced in each case is rather low-octane-number motor fuel. If aviation gasoline were produced, added investment and operating costs would be involved.

The Fischer estimate was prepared in this country on the basis of process information obtained abroad. It will be noted that coal hydrogenation shows an investment of \$12,800 per barrel per day gasoline capacity, while the Fischer process indicates \$7,600 per barrel per day. These figures are based on plants of the capacity shown and would decrease somewhat for larger units, particularly in the case of coal hydrogenation, where it is estimated that a plant of 30,000 barrels per day capacity would show a cost of roughly \$7,500 per barrel per day. These investment costs should be compared with the costs of \$1,150 per barrel per day for a high-pressure hydrogenation plant charging crude petroleum, \$1,750 per barrel per day for a present European design Fischer plant charging natural gas as raw material and \$700 per barrel per day for a modern refinery starting from crude petroleum.

The direct operating costs including normal overhead but exclusive of depreciation amount to 14.7 cents per gallon of gasoline for the Fischer process and 15.9 cents per gallon for coal hydrogenation. When 10 percent depreciation on process equipment and 5 percent on auxiliaries is included, the total costs are 19.2 cents per gallon and 22.6 cents per gallon. For a plant having a capacity of 30,000 barrels per day it is estimated that the cost of gasoline exclusive of depreciation would be about 12 cents per gallon and about 15.5 cents per gallon with depreciation. These costs should be compared with costs of other methods of producing gasoline, as follows:

TABLE I.—Summary table

	Fischer process	Coal hydrogenation
Plant capacity, gasoline, barrels per day.....	3,960	2,950
Coal required (ash and moisture free):		
Short tons per day.....	2,700	1,500
Short tons per barrel of gasoline.....	0.68	0.51
Gasoline quality:		
A. P. I. gravity.....	66	62.5
A. S. T. M. octane number.....	68	70
Estimated investments: ¹		
1942 basis.....	\$30,000,000	\$37,700,000
Dollars per barrel of gasoline per day.....	\$7,600	\$12,800
Operating costs: ²		
Excluding depreciation, cents per gallon of gasoline.....	14.7	15.9
Including depreciation, cents per gallon of gasoline.....	19.2	22.6
Estimated steel requirements (tons): ³		
Including all steel, forgings, alloy, compressors, pumps, etc.....	35,100	41,700
Tons per barrel of gasoline per day.....	8.9	14.1

¹ See tables II and III for details.

² See tables IV and V for details. Coal taken at \$2.75 per ton, ash and moisture free.

³ These estimates are quite approximate. See tables VI and VII for details.

TABLE II.—Investment for production 2,950 barrels per day gasoline by coal hydrogenation

	Marks in 1936	Dollars in 1936 at 40 cents per RM	Estimated cost in 1942 ¹
Hydrogen manufacturing and compressing.....	14,989,000	\$6,000,000	\$8,100,000
Hydrogenation.....	19,067,000	7,620,000	10,300,000
Distillation and tankage.....	3,680,000	1,470,000	1,990,000
Tie-in lines.....	397,000	160,000	220,000
Spare parts.....	800,000	320,000	430,000
Utility supply, shops, laboratory, etc.....	25,000,000	10,000,000	13,500,000
Engineering.....	² 63,933,000	² 25,570,000	² 34,540,000
First charge catalysts.....	3,800,000	1,520,000	2,050,000
	2,000,000	800,000	1,080,000
	69,733,000	27,890,000	37,670,000

Say \$37,700,000

¹ Taking 1.35 times 1936 cost.² Contingencies at 10 percent included in individual items.

TABLE III.—Investment for production 3,960 barrels per day of gasoline by Fischer synthesis using bituminous coal

	Estimated cost in 1938	Estimated cost in 1942 ¹
Synthesis gas production.....		\$12,000,000
Synthesis plant.....	\$7,000,000	8,800,000
Fischer product cracking plant.....	1,600,000	2,000,000
Catalyst plant.....		750,000
Utility supply, shops, etc.....		5,300,000
Engineering.....		² 28,850,000
Initial catalyst charge.....	180,000	1,000,000
		225,000
		30,075,000

Say \$30,000,000

¹ Taking 1.25 times 1938 cost.² Contingencies at 10 percent included in individual items.

Comparison of methods for motor gasoline production

	Approximate investment per barrel of motor gasoline per day ³	Approximate tons of steel per barrel of motor gasoline per day	Approximate gasoline direct cost, including norm. O. H. but excluding depreciation	Approximate gasoline total cost, including norm. O. H. and 10 percent depreciation
			Cents	Cents
1. High-pressure coal hydrogenation.....	\$12,800	14.1	15.9	22.6
2. Fischer process, European design starting from coal.....	7,600	8.9	14.7	19.2
3. Fischer process, European design starting from natural gas ¹	4,750	6.5	6.0	8.8
4. Modern high-pressure hydrogenation of petroleum ^{1,2}	1,150	1.4	4.8	5.5
5. Modern oil refinery, crude at \$1.20 per barrel ⁴	700	.7	5.1	5.3
6. Modern oil refinery, crude at \$2 per barrel ⁴	700	.7	8.3	8.5

¹ Natural gas at 5 cents per thousand cubic feet.² Crude at \$1.20 per barrel.³ 1942 costs for complete plant including all utility supply and auxiliaries.⁴ Crude price at the well.

In 1938, the Falmouth committee (Committee of Imperial Defence, subcommittee on oil from coal) appointed by the British Government to assay the advisability of installing in England hydrogenation or Fischer process plants for making gasoline from coal issued its careful and comprehensive report (copy of which was inserted in the records of this committee). It was doubtless from study of such figures as contained in the table just presented which led the Falmouth committee (par. 230, p. 46) to conclude "in these circumstances, it is abundantly evident that so long as the price of imported fuel remains in the neighborhood of the present figure, the case for home-produced oil, judged by purely economic standards, falls to the ground. Hence, it follows that if it is desirable for any of the reasons mentioned in paragraph 238 to produce oil from coal or other indigenous material, Government assistance in one form or another must be forthcoming."

As pointed out previously, the Fischer process can also be adapted to conversion of natural gas into gasoline. Plants for this purpose involve investment and steel requirements of considerably less than those for plants to start from coal. If sufficient development work were done in the United States, it is probable that gasoline produced from natural gas (at from 3 to 5 cents per 1,000 cubic feet) by the Fischer process can be made at a cost competitive with gasoline produced from crude, or, in other words, at much less than the cost involved from coal, as original raw material. A number of possibilities for improvement in the Fischer synthesis step are known to exist, and Standard Oil Co. (New Jersey), with several cooperating companies, had been planning to conduct an aggressive research and development program in an attempt to carry these possibilities to completion. It has been necessary, however, to utilize all technical and operating personnel on seeking solutions of problems known to be vital to the war effort, and, hence, this aggressive research program on the Fischer synthesis has been postponed until after the war.

EXPERIENCE AVAILABLE

Although oil hydrogenation has been practiced extensively in the United States, there is no commercial experience available on coal hydrogenation or on Fischer synthesis. Some experimental work on coal hydrogenation has been carried out by the Bureau of Mines and a small amount of laboratory work has been conducted on the Fischer operation.

Coal hydrogenation.—The production of gasoline from coal involves two major steps: (a) Hydrogenation of coal into heavy oil; (b) second stage hydrogenation of heavy oil to gasoline.

Full experience is available in this country on the second step. In the first step engineering information would be required on coal grinding and pasting, paste pumping, coal hydrogenation, type of catalysts, finishing final gasoline, etc. Full information could be obtained from Imperial Chemical Industries of Great Britain, who operate a commercial plant. If commercial plants were to be built it probably would be desirable to conduct pilot plant tests on specific American coals; such tests could be run by the Imperial Chemical Industries in England or this information may be available from work carried out by the Bureau of Mines.

Fischer synthesis.—All of Ruhr-Chemies information on this process was made available in 1933. Sufficient information is available for design of plants, although it is doubtful whether the best and cheapest plant could be constructed from the information available. It would, however, be necessary to conduct some work on catalyst manufacture and catalyst testing to make sure that the catalyst could be duplicated in this country.

Numerous possibilities for improvement in the process both as regards investment and product quality merit investigation. A comprehensive development program had been projected along these lines, but has been postponed in order to permit concentrating on solution of problems vital to the war effort.

The Fischer synthesis can also be used to convert natural gas into gasoline and plants for this purpose represent investments which are much lower than those involved in Fischer synthesis with coal as starting material. Furthermore, if sufficient development work were done and if it were successful, the cost of producing gasoline by the Fischer synthesis from natural gas probably would be competitive with the cost of gasoline produced from crude—thus Fischer synthesis gasoline from natural gas will be very much cheaper than Fischer synthesis produced from coal.

INVESTMENTS

Coal hydrogenation.—A detailed estimate was available for a coal hydrogenation plant producing 2,950 barrels per calendar day of gasoline as prepared in 1936 by associates in the Netherlands. This cost was expressed in marks and in table II this cost has been corrected to 1936 costs in dollars, using a figure of 40 cents per mark which may be questionable. However, comparison of these coal hydrogenation costs with similar estimates prepared in England led to the assumption at that time that the conversion using a 40-cent mark was satisfactory. United States costs in 1936 were then corrected to 1942 conditions, using a factor of 1.35. This plant, although of a capacity extensively used abroad, might be considered as of rather small capacity here and investments costs would be somewhat lower if larger capacities were employed. The items shown for engineering were left exactly as in the estimates made abroad and may be slightly low, based on present-day American conditions.

Fischer synthesis.—The estimate used here is based on a design prepared in this country based on the Ruhr-Chemie data for the Fischer synthesis proper. Figures were obtained from local equipment suppliers on cost of water-gas generators using coal as the feed material. These costs have likewise been corrected to 1942 conditions.

OPERATING COSTS

Bituminous coal hydrogenation.—The coal consumption required for this plant was obtained from information abroad indicating about 0.51 tons of coal per barrel of gasoline produced. This includes coal for hydrogenation, hydrogen production, and for generation of all utilities. The consumption is expressed in terms of ash- and moisture-free coal. Corrections are therefore necessary to obtain tons of coal as received.

In the operating costs a price of \$2.75 per ton of ash- and moisture-free coal has been assumed. Both operating and investment costs will vary to some extent depending on the type of bituminous coal employed. Labor requirements are based directly upon those indicated by experience abroad using American labor rates.

Depreciation is included at 10 percent for main process equipment, with 5 percent on utilities and auxiliaries. A burden charge of 60 percent is used on maintenance, supplies and labor. This charge is representative of costs in the petroleum industry and includes items such as shops, fire protection, medical department, guards, general roads, utility distribution, etc. On general administration, which covers executive control, a corresponding figure of 10 percent has been applied, which likewise is in line with experience in the industry.

It will be noted from table IV that the cost of producing gasoline without depreciation on investment in a 2,950-barrel-per-day plant is 15.9 cents per gallon with a total cost of 22.6 cents. With larger scale production, for example, at a capacity of around 30,000 barrels per day, it is believed that the total cost would be reduced to about 16 cents per gallon. Undoubtedly some of the high cost shown for the operation is a reflection of the high investment costs based on 1942 conditions. In any event, both the investment cost and operating cost estimates are reasonably close to those contained in the British Falmouth Committee Report (February 1938) which gave \$11,300 per barrel of gasoline per day as investment; direct operating cost, before depreciation, of 12 cents per United States gallon; and operating cost, including 10 percent depreciation of 17½ cents per United States gallon.

Fischer synthesis.—The figures used on this operation are set up on the same basis as used for coal hydrogenation. Detailed operating costs were worked out in this country based on the Ruhr-Chemie's process data for the Fischer synthesis proper. To these costs have been added figures obtained in the United States covering water gas production from coal. It is doubtful that in using the Fischer process any great reduction in cost would be obtained by constructing larger sized plants.

It will be noted from table V that the cost ex depreciation for gasoline by the Fischer process amounts to 14.7 cents per gallon with a total cost of 19.2 cents per gallon.

The crude Fischer product in this estimate is worked up by thermal cracking (gas reversion type) into motor fuel. Since these figures were originally prepared, catalytic cracking has been developed and it is quite possible that the Fischer product might be worked up in this way whereby higher octane number material would be produced.

TABLE IV.—*Estimated daily operating costs for production 2,950 barrels per day gasoline by hydrogenation of bituminous coal*

	Tons per barrel gasoline	Tons per day
Coal required, ash and moisture free:		
For hydrogenation.....	0.220	646
For power gas production.....	.136	401
For steam and power.....	.141	414
For H ₂ production.....	.030	89
Residue credit.....	.017	—50
	.510	1500
	Dollars per calendar day	Cents per gallon gasoline
(1) Coal, 1,500 tons, at \$2.75 per ton, ash and moisture free.....	4,130	3.3
(2) Labor, 111 men per shift \$1.20 per hour.....	3,200	—
(3) Supervision, 10 percent of (2).....	320	—
(4) Maintenance, 3 percent of \$37,700,000.....	3,110	—
(5) Catalysts and supplies.....	1,700	—
(6) Pay-roll overhead—15 percent of (2, 3, and 50 percent 4).....	800	—
(7) Water, 0.34 thousand gallons per gallon gasoline, at 0.5 cents per thousand gallons.....	210	—
(8) Fresh water, 0.0091 thousand gallons per gallon gasoline, at 2.0 cents per thousand gallons.....	20	—
(9) Burden, 60 percent of 2, 3, 4, 5.....	4,450	—
(10) General administration, 10 percent of 2, 3, 4, 5.....	742	—
(11) Insurance and taxes, 1 percent of \$37,700,000.....	1,035	—
Total excluding depreciation.....	19,710	15.9
(12) Depreciation:		
10 percent on \$23,000,000.....	6,300	—
5 percent on \$14,700,000.....	2,010	—
Total cost.....	28,020	1 22.6

¹ For a plant having a capacity of 30,000 barrels per day, the total cost of gasoline would be 15–16 cents per gallon.

TABLE V.—*Estimated operating cost for production 3,960 barrels per day gasoline by Fischer process from bituminous coal*

Coal required, ash and moisture-free basis for synthesis gas production and all auxiliaries:		
Tons per barrel gasoline.....		0.680
Tons per day.....		2,700
	Dollars per calendar day	Cents per gallon
(1) Coal, 2,700 tons, at \$2.75.....	\$7,420	4.45
(2) Operating labor—50 men per shift, at \$1.20 per hour.....	1,440	—
(3) Supervision—10 percent of (2).....	140	—
(4) Maintenance—8 percent of \$30,000,000.....	6,580	—
(5) Catalyst and supplies.....	940	—
(6) Pay roll, overhead—15 percent of (2), (3), and 50 percent of (4).....	730	—
(7 and 8) Water (make-up only).....	40	—
(9) Burden—60 percent of (2), (3), (4) and (5).....	5,460	—
(10) General administration—10 percent of (2), (3), (4) and (5).....	910	—
(11) Insurance and taxes—1 percent per year on investment.....	820	—
Total ex depreciation.....	24,480	14.7
(12) Depreciation:		
10 percent on \$24,000,000.....	6,580	—
5 percent on \$6,000,000.....	820	—
Total costs.....	31,880	19.2

Production of aviation gasoline by the Fischer process has not been studied. Added costs would undoubtedly be involved probably with some reduction in yield.

As stated previously, marked possibilities for improvement in the process are thought to exist particularly when using natural gas instead of coal as raw material.

STEEL REQUIREMENTS

Coal hydrogenation.—Good information is not available on the direct steel requirements for coal hydrogenation. The method used in approximating the steel requirements is shown in table VI. The estimate as obtained abroad was broken down into material cost for ordinary steel, forgings, compressors, and pumps, as shown in table VI. These items were converted to United States dollars and then divided by the cost per ton of steel existing at that time. Alloy steel was determined as a percentage on total steel tonnage based on experience with hydro plants in this country. This method is approximate and only provides a general idea of steel requirements.

Fischer synthesis.—In the case of the Fischer synthesis plant, an estimate had been prepared in this country and steel was estimated directly from this estimate as shown in table VII (13,426 tons). A corresponding figure was obtained for steel for the gas preparation equipment (11,000 tons). Steel for the reversion plant, catalyst plant, and utility supply was obtained, using the same method as employed for the coal hydrogenation plant. Pump and compressor tonnage as shown in table VII was obtained in a similar way using a unit cost of \$1,700 per ton, except in the synthesis plant, where an actual weight of steel was available.

COMPARISON OF COSTS WITH OTHER METHODS

Production of gasoline from bituminous coal by hydrogenation or Fischer synthesis should be compared with the following other methods:

- (a) Crude oil processing in a modern refinery.
- (b) High pressure hydrogenation of crude petroleum.
- (c) Fischer synthesis starting with natural gas.

Table VIII summarizes the investments, steel requirements, and operating costs for these methods in comparison to production from coal.

TABLE VI.—Approximate steel requirements, coal hydrogenation plant, 2,950 barrels per day gasoline

	Material cost in 1936 marks	Dollars in 1936	Estimated dollars per ton ¹ in 1936	Tons required
Steel towers, drums, piping, miscellaneous.....	32,824,000	13,130,000	425	31,000
Forgings.....	5,505,000	2,200,000	450	4,900
Alloy.....	775,000	310,000	(²)	2,140
Compressors.....	3,305,000	1,320,000	600	2,200
Pumps.....	6,841,000	2,740,000	1,250	2,000
Total.....				41,700

¹ Estimate based on 1942 and 1930 construction costs corrected to 1936 conditions.

² Tons alloy estimated by taking 7 percent weight of steel towers, drums, piping, miscellaneous, plus forgings.

TABLE VII.—Approximate steel requirement for Fischer plant using coal, 3,960 barrels per day gasoline

	Estimated material cost in 1942	Estimated dollars per ton	Tons required
Steel towers, drums, piping, etc.:			
Gas production plant.....			11,000
Synthesis plant.....			13,425
Cracking plant.....	\$1,400,000	575	2,430
Catalyst plant.....	530,000	575	950
Utilities and shops.....	3,000,000	500	6,000
Subtotal.....			33,816
Pumps and compressors:			
Gas production plant.....	230,000	1,700	135
Synthesis plant.....			746
Cracking and catalyst plants.....	150,000	1,700	90
Utilities and shops.....	500,000	1,700	295
Subtotal.....			1,266
Total.....			35,082

TABLE VIII.—Comparison of methods for motor gasoline production

	Approximate dollars in- vested ¹ per barrel motor gasoline per day	Approximate tons steel per barrel motor gasoline per day	Approximate gasoline ² direct cost, including nor- mal overhead but excluding depreciation	Approximate gasoline ² total cost, in- cluding nor- mal overheads and 10-percent depreciation
			<i>Cents</i>	<i>Cents</i>
1. High-pressure coal hydrogenation . . .	\$12,800	14.1	15.9	22.6
2. Fischer process, European design, starting from coal	7,600	8.9	14.7	19.2
3. Fischer process, European design, starting from natural gas ³	4,750	6.5	6.0	8.8
4. Modern high-pressure hydrogenation of petroleum ⁴	1,150	1.4	4.8	3.5
5. Modern oil refinery, ⁵ crude, at \$1.20 per barrel ⁶	700	.7	5.1	5.3
6. Modern oil refinery, ⁵ crude, at \$2 per barrel ⁶	700	.7	8.3	8.5

¹ 1942 costs for complete plant, including all utility supply and auxiliaries.

² Octane number approximately 68-70 American Society for Testing Materials.

³ Natural gas at 5 cents per 1,000 cubic feet.

⁴ Crude at \$1.20 per barrel.

⁵ Using thermal cracking basis.

⁶ Crude price at the well.

It will be observed from the table that production of gasoline in a modern oil refinery starting with crude petroleum is the cheapest method for production of gasoline today. The current investment per barrel of motor gasoline for a complete refinery amounts to about \$700 per barrel of gasoline per day, and the cost of gasoline production is about 5.3 cents per gallon for crude at \$1.20 per barrel at the well (lower than current crude prices). When, as and if crude supplies become more limited, and crude price should increase to \$2 per barrel, it will be noted from the table that the gasoline cost is 8.5 cents per gallon at the refinery, which is still considerably less than the cost of production from coal by either hydrogenation or the Fischer process. Steel requirements are also less, amounting to 0.7 tons per barrel per day gasoline capacity compared to 8-14 tons per barrel per day for treatment of coal.

As mentioned previously, the Fischer process can be adapted to conversion of natural gas into gasoline. Estimates made up using present European design for the synthesis equipment have been summarized in table VIII. It will be observed that the estimated investment is less than for production of gasoline from coal, although higher than that by present crude petroleum refining, as would be expected. The estimated cost of production of gasoline from 3 to 5 cents natural gas appears to be competitive with production from crude when a crude price of \$2 per barrel is realized. Steel requirements likewise are less than production from coal, but much higher than crude oil refining. A number of possibilities for improvement of the Fischer process are believed to exist and if sufficient development work were done and if successful, it is probable that gasoline produced from natural gas could be made at a cost competitive with gasoline from crude.

High-pressure hydrogenation of petroleum is well worked out and represents the most effective utilization of existing petroleum supplies. This method shows considerably lower investments than production from coal or Fischer synthesis using natural gas, although somewhat higher than with present-day refining methods. The cost of gasoline is considerably lower than production from coal

and appears competitive with present-day refining methods when somewhat higher crude prices apply. Steel requirements are much less than for coal hydrogenation or Fischer process.

It has been our picture that for present price levels, production of gasoline by modern refinery methods, which include catalytic cracking, represent the cheapest methods for production of gasoline and likewise require the least steel. Moreover, it is felt that if sufficient development work were done on the production of gasoline from natural gas by the Fischer process, and if this work were successful, this method might be competitive with present-day refining of crude petroleum. As petroleum supplies become more limited, and the price of crude thereby increases, other competitive methods such as those discussed above, will become more attractive. The first of these to come into use would probably be high pressure hydrogenation of crude petroleum. Since this method uses petroleum very efficiently, the supply of petroleum would be extended since all of the crude can be converted into gasoline without production of heavy fuel. We have pictured that only after the application of petroleum hydrogenation and Fischer process using natural gas would attention be given to production of gasoline from coal. From the figures in this memorandum it appears that production from coal might first be effected using the Fischer process rather than coal hydrogenation since investments and operating costs are somewhat lower. On the other hand, it should be kept in mind that if larger scale coal hydrogenation plants were erected than shown in detail in this memorandum, the costs for coal hydrogenation would be competitive with those of the Fischer process.

Senator O'MAHONEY. Mr. Duce, are you ready to proceed?

Mr. DUCE. Yes, sir.

Senator O'MAHONEY. Will you give your name to the reporter?

STATEMENT OF JAMES TERRY DUCE, DIRECTOR, FOREIGN DIVISION, PETROLEUM ADMINISTRATION FOR WAR

Mr. DUCE. Mr. Chairman and gentlemen, my name is James Terry Duce. I am at present Director of the Foreign Division of P. A. W. I have been a geologist and executive with the Texas Co. for 25 years. At present I am on leave from the California Arabian Standard Oil Co., and my main task has been to follow petroleum developments abroad.

I am going to testify today about the reserve situation abroad, as it exists, and with your permission, Mr. Chairman, I will go over to my charts and my map over here.

Senator O'MAHONEY. Very well, sir.

Mr. DUCE. I think these are large enough so you can read them. This (pointing to chart No. 1) shows the estimated world revenues in 1942 as we found them in December of last year. You will note that the overwhelming proportion of crude reserves of the world, outside of the United States lies in Russia—8,500,000,000; Venezuela, 5,600,000,000; Dutch East Indies, 1,250,000,000; and the Persian Gulf countries grouped together, 16,450,000,000.

CHART No. 1.—*Estimated world's reserves, 1942, and world's production, 1938, with percentages*

	World reserves, 1,000 of barrels, 1942	Percent world reserves, 1942	World production 1938, 1,000 barrels	1938 production expressed as percent of 1942 reserves
United States of America.....	20,000,000	36.369	1,264,970	6.325
Union of Soviet Socialist Republics.....	8,500,000	15.457	210,000	2.471
Venezuela.....	5,600,000	10.183	190,000	3.393
Colombia.....	500,000	0.909	22,000	4.420
Mexico.....	675,000	1.228	38,000	5.639
Peru.....	160,000	0.291	17,200	10.750
Argentina.....	250,000	0.455	16,700	6.680
Ecuador.....	27,000	0.049	2,260	8.370
Bolivia.....	40,000	0.073	150	0.375
Brazil.....	1,000	0.002	-----	-----
Trinidad.....	400,000	0.727	18,000	4.500
Canada.....	135,000	0.245	8,000	5.926
Albania.....	21,000	0.038	730	3.571
Czechoslovakia.....	8,000	0.015	150	1.875
France.....	5,600	0.010	570	10.179
Germany.....	83,000	0.151	4,300	5.181
Austria.....	50,000	0.091	400	0.800
Hungary.....	75,000	0.136	1,000	1.333
Italy.....	1,000	0.002	100	10.000
Poland.....	44,000	0.080	3,970	9.023
Rumania.....	467,000	0.849	49,200	10.535
Netherlands East Indies (includes Borneo-New Guinea).....	1,250,000	2.273	57,600	4.608
Burma.....	100,000	0.182	7,500	7.500
India.....	50,000	0.091	2,500	5.000
Japan.....	25,000	0.045	2,680	10.720
Egypt.....	75,000	0.136	1,600	2.133
Persian Gulf area.....	16,450,000	29.913	115,380	0.701
Others.....	-----	-----	9,800	-----
Total.....	54,992,600	100.000	2,440,800	3.718

Senator O'MAHONEY. Is that in the order of size?

Mr. DUCE. No, sir. The next one to the United States is the Persian Gulf area; then comes Russia, Venezuela, and then the Dutch East Indies.

Senator O'MAHONEY. What is the United States figure?

Mr. DUCE. Twenty billion. I am using the rough figure of 20,000,000,000. I believe the latest figure is approximately 21,000,000,000.

This shows the situation at the present time with total world reserves of about 55,000,000,000 barrels.

This (pointing to chart No. 2) shows the areas in which it may be expected that petroleum will be produced from wells in the future; in other words, these are the areas where oil will be found. It is constructed on the basis of our knowledge of the geology of the world.

CHART No. 2.—*Arcas of world classified as to future prospects for oil*

[Does not consider present discovered reserves]

	Very great	Large	Locally important	Small
North America:				
United States of America:				
Gulf coast.....	●			
Midcontinent (includes west Texas and New Mexico).....	●			
Rocky Mountains.....		●		
California.....		●		
Eastern.....			●	
Mexico.....		●		
Canada.....		●		
Central America.....				●

CHART No. 2.—Areas of world classified as to future prospects for oil—Continued

	Very great	Large	Locally important	Small
South America:				
Venezuela.....	●			
Colombia.....	●			
Peru.....		●		
Ecuador.....			●	
Paraguay.....			●(?)	
Chile.....				●
Argentina.....			●	
Bolivia.....			●	
Brazil.....				●
Europe:				
England.....				●
Germany.....			●	●
France.....				●
Italy.....				●
Albania.....				●
Poland.....			●	
Roumania.....		●		
Spain.....				●
Denmark.....				●
Hungary.....			●	
Czechoslovakia.....				●
Estonia.....				●
Russia:				
Baku region.....	●			
North Caucasus.....	●			
Perm Basin.....	●			
Emba region.....		●		
Asia:				
Russia:				
East Ural.....		●		
Sakhalin.....		●		
North Aretie.....		●		
Turkaman region.....	●		●	
Tadjikstau and Khirgez.....		●		
Irak.....	●			
Iran.....	●			
Arabia.....	●			
Kuwait.....		●		
Qatar.....		●		
Syria.....			●	
Bahrein.....			●	
Turkey.....			●	●
India.....			●	
Afghanistan.....			●	
Burma.....			●	
Palestine.....			●	
Netherland East Indies.....		●		●
China.....				●
Japan.....				●
Australia.....				●
Africa:				
Egypt.....			●	
Mozambique.....				●
Angola.....				●
French North Africa.....				●
Madagascar.....				●

The most favorable areas are represented in green, the less favorable in yellow. Those areas indicated in red and blue will not produce petroleum of any great importance.

Again I call your attention to the concentration of the favorable areas in Russia, these immense areas in here [indicating]; the Near East, this area in here [indicating]; the Dutch East Indies, these small green areas down here [indicating]; and Europe, outside of Russia—

Senator O'MAHONEY (interposing). Now Mr. Duce, would it be proper to point out—

Mr. DUCE (continuing). And South America.

Senator O'MAHONEY. Would it be proper for me to ask at this point whether the possible areas which are marked in green on this map, in Russia and Siberia, have been explored to anything like the extent to which the reserves or the possible areas in the United States have been explored?

Mr. DUCE. That is a point I was coming to, Senator.

The productive areas in Venezuela and Colombia, in here [indicating], will probably extend gradually by exploration down through this green area into Ecuador and Bolivia. That is the area behind the Andes that is densely forested, and the exploration will be slow.

The areas in green in the Persian Gulf, these areas in here [indicating], are very favorable, not only because of the comparatively large green area but because of the great richness of the deposits found.

I might add here that in the United States we have drilled one well for every 3 square miles of land, whereas in foreign countries there has been but one well drilled to every 500 square miles.

Senator O'MAHONEY. Will you give me that comparison again, please?

Mr. DUCE. There has been one well drilled in the United States for approximately every 3 square miles of land surface, and one well to every 500 square miles abroad.

Senator O'MAHONEY. Now, if you were to make a comparison with respect to Russia alone, what would it be?

Mr. DUCE. I think the ratio would be about the same if we take the prospective areas.

Senator O'MAHONEY. Well, that shows clearly, if those figures are correct—and I assume they are—that the United States, having been in the lead in the manufacture and utilization of gasoline engines, has led the world in the exploitation of its own resources, whereas Russia and the rest of the world are lagging far behind. Therefore, if this map correctly indicates the possibilities of the future, it would be proper to say, would it not, that the future, so far as petroleum is concerned, belongs to Russia?

Mr. DUCE. To Russia and these other areas.

Senator O'MAHONEY. Well, that area to which you have just pointed, in Arabia, doesn't begin to cover the extent that Siberia and Russia and Europe do?

Mr. DUCE. That is right; but I think there is one other thing that this map does not indicate, and that is the comparative richness of the areas. In testifying before another committee recently, I put it this way: This indicates where you can hunt. Now, it doesn't indicate the number of birds you will find in each area. Now, I would think that the birds, for instance, in this area down here, would average much larger than in the big area up here.

Senator O'MAHONEY. That is to say—and I am repeating this for the benefit of the record—that more oil, in your judgment, will be discovered per square mile in Arabia than in Russia?

Mr. DUCE. That is right, sir.

Senator MURDOCK. May I ask this question? Referring to the testimony of the previous witness about his optimism as to new discoveries, as I understand you we have drilled one well for each 3 square miles?

Mr. DUCE. Yes, sir.

Senator MURDOCK. Doesn't that indicate that the favorable locations in the United States have been very well explored?

Mr. DUCE. They have been pretty well explored. I am going to put myself here on record a little bit later with this chart, showing what I think of that position.

Senator MURDOCK. On the question of new discoveries?

Mr. DUCE. Yes; although I don't claim to be an expert on the United States. I will leave that to Mr. Heroy and those people who will follow me.

I am impressed at the present time by the higher grade of the prospects which we know in the foreign countries when compared to those in the future in the United States. That is to say, the oil is easier to find abroad, and is found in larger quantities, I might add parenthetically, because we have done the easiest things in the United States already. I might add that the 300 fields that have been found abroad in the last 20 years have had an average estimated ultimate production of about 100,000,000 barrels each, while the average field found at the present day in the United States does not exceed 2,000,000 barrels, average, each.

Now, I want to call your attention here to the geographic distribution of these areas in the Near East and in Russia, and their overwhelming importance in the world's oil trade of the future. These areas are as far as possible removed on this globe from the United States. Bahrein, here, where there is an American refinery at the present day, is exactly 12,000 miles from San Francisco in both directions.

Now chart 2, this chart up here, shows my guess as to the future prospects in the various foreign countries and the United States. I have classified the areas as to future prospects into four classes—very large, large, locally important, and small.

Senator O'MAHONEY. Now, this guess of yours is based upon long study and experience, isn't it?

Mr. DUCE. That is right, sir.

Senator O'MAHONEY. I just don't want it to go in the record as a mere guess.

Mr. DUCE. Well, it is what I might call an informed guess. I have checked it with a good many of my geological friends who know the situation in various areas, and while we have had some small disputes, it represents an average opinion.

Senator O'MAHONEY. I say that because I have a pretty good opinion of your capacity to guess correctly.

Mr. DUCE. Thank you very much, sir.

If I might say something about this chart off the record, because I wouldn't like this to go into the record?

Senator O'MAHONEY. Very well.

(Discussion off the record.)

Mr. DUCE. Most of the oil, the future well oil, will be produced in areas remote from the United States, and for that reason synthetic oil production is most important in case of war. Reserves are important to us in wartime only when we can reach them without danger.

I think that is all I have to say, Mr. Chairman.

Senator O'MAHONEY. Congressman Randolph has a question he desires to ask.

Congressman RANDOLPH. Do you agree with the earlier witness, Mr. Russell, that there will be no appreciable increase of gasoline and fuel-oil products in the United States?

Mr. DUCE. Let me see if I have your question right, Congressman, that there will be no appreciable increase in the production of fuel oil and gasoline in the United States?

Congressman RANDOLPH. Mr. Russell said there would be no appreciable increase in the use of gasoline and fuel oil in the United States.

Senator O'MAHONEY. That was his assumption which he said he thought was wrong.

Mr. DUCE. Let me say something in connection with that, which is another guess on my part ahead of time. One of the most interesting characteristics of man is his desire to be somewhere where he isn't. Now in the airplane we have got a new device for being somewhere where we are not at the present time, and I think it is going to grow, its use is going to grow very much. That means that people are going to travel more per day than they did in the past, and the gasoline consumption is going to go up.

Congressman RANDOLPH. They are going to travel more by car, too, are they not?

Mr. DUCE. Yes; as the roads get better we are going to have more and more automobile travel.

Congressman RANDOLPH. I had a farmer in West Virginia tell me that he had been seeing a jeep running over our mountain roads in connection with Army maneuvers, and he said, "After this war is over I am going to have not just one but a half a dozen jeeps if I can get them for my mountain farm." We haven't been able to get any motor vehicle which could be used on that rough terrain, but the development of the jeep opens up a new field for another agricultural use of gasoline.

But it is certainly a fact that we are going to have increased uses for mechanical devices which will be powered with gasoline—you will agree to that?

Mr. DUCE. Absolutely, and it is going to extend all over the world. I think that one of the things that everybody in the world wants to possess is an automobile, with the ability to go somewhere else.

Congressman RANDOLPH. And farming will be highly mechanized in the future?

Mr. DUCE. Yes; and they will be building new roads in areas where roads have never been seen before. I think one example is the Burma Road. All those things are going to have cars running on them, so there will be an increasing demand for gasoline and oil all over the world.

Senator MURDOCK. Did I construe Mr. Russell's testimony correctly in the assumption I made in interrogating the present witness, that Mr. Russell thought that there would be important discoveries made in the United States?

Senator O'MAHONEY. Yes, he said that; that is right.

Senator MURDOCK. That is the way I understood it. When you think of an exploration that already gives us one well to each 3-mile square, I am beginning to think that we are pretty well explored in this country.

Mr. DUCE. That is the average. There are large areas where no testing has been done, and we must also remember that we also have to go down still further. I was impressed by the fact, in looking at the record the other day, that when the last war started, the deepest

well in the United States was somewhat over 5,000 feet; it wasn't a commercial producer. At the present day there are wells over 15,000 feet deep. So we have increased our ability to drill deep by three times during this last 20 years.

Senator GURNEY. I would like to clear up one point if I may. I find it hard to follow this. We had a statement made at the start of the hearing this morning that we are consuming gasoline at the rate of 1.4 billion barrels per year. Now this chart here only goes to 1940, and it shows 589 million barrels per year of motor fuel, which would be about 0.6 billion barrels. Has it jumped that much in 2 years?

Mr. DUCE. I think whoever was testifying at that time must have made a mistake and testified as to the amount of crude oil.

Senator GURNEY. He was giving the figure of 1.4 billion barrels as applying to crude oil?

Mr. DUCE. That is right, in the United States.

Senator O'MAHONEY. Of course, that table there does not begin to approximate the use of motor fuel for war purposes in 1941, 1942, and 1943.

May I ask you, Mr. Duce, what the Foreign Division of the P. A. W. has been doing, if anything, and if you may testify, to accelerate the exploration for oil in these foreign areas?

Mr. DUCE. Well, we have keyed our exploration there to the requirements that could be lifted at the present time. It is a question of getting steel. The companies are quite willing to go ahead with an extensive exploration program in these various foreign countries, but the steel hasn't been available to give to them. Now as the requirements increase, as we get more tankers to move the oil, we are increasing the amount of steel which they get, and exploration is going ahead. That is particularly true in the countries around the Carribbean, Colombia, and Venezuela, which are directly contributory to our situation.

Senator O'MAHONEY. Well, if Arabia is a comparatively rich source of oil, then the exploratory work which is being stimulated by your organization may be expected to bring in new sources of oil which will relieve the strain upon American reserves; is that correct?

Mr. DUCE. That is right.

Senator O'MAHONEY. Are there any other questions? If not, we are very grateful to you, Mr. Duce.

Mr. DUCE. Thank you, sir.

Senator O'MAHONEY. In order to suit the convenience of witnesses who must go, I am going to make another change in the order and ask that Mr. H. T. DeBardeleben, president of the DeBardeleben Coal Corporation of Birmingham, Ala., take the stand.

STATEMENT OF HENRY T. DeBARDELEBEN, PRESIDENT, DeBARDELEBEN COAL CORPORATION, BIRMINGHAM, ALA.

Mr. DeBARDELEBEN. My name is Henry T. DeBardeleben, president of the DeBardeleben Coal Corporation, Birmingham, Ala.

I am presenting a statement prepared by Dr. M. H. Fies, who is vice president of our company and who is unable to be present by virtue of his assistant's serious illness, and my absence and his at the same time wouldn't work out.

Senator, I can read this statement if you wish it, or we can file it and save your time thereby.

Senator O'MAHONEY. Well, I think it would be well to develop the ideas which are contained in this statement, and if you prefer to talk extemporaneously or prefer to read the statement, it is quite agreeable.

Mr. DEBARDELEBEN. This matter has been given thought by our vice president, Mr. Fies, and the statement itself is prepared by him, and it will be best that I should follow the text, I believe.

Senator O'MAHONEY. Very well.

Mr. DEBARDELEBEN. During a period exceeding a quarter of a century, the writer has been an earnest proponent of the United States Bureau of Mines. He has been convinced beyond any measure of doubt that the personnel of the Bureau in the main is composed of men who are unselfishly devoted to the cause of research as it relates to mines and minerals. It is to be regretted that the average citizen knows so little about the outstanding achievements of the Bureau of Mines in the thirty-odd years of its existence. Perhaps there would be less disposition to make the word "bureau" all-inclusive. The men in this department of the Government have labored modestly and have manifested the finest sensibilities in their relationship with the coal industry. They have been efficient, tolerant, and progressive.

The author of Senate bill S. 1243 likewise gives evidence of his confidence in the Bureau of Mines. In its advocacy before the Senate, if this bill is favorably acted upon by this Subcommittee on War Minerals and the full Committee on Public Lands and Surveys, it is respectfully suggested that this fact be definitely emphasized and placed in the record: The path of research is long and tortuous and many times futile, but the assurance can be fairly given that if present methods for the production "of synthetic liquid fuels from coal and other substances" can be improved upon or new processes developed, the United States Bureau of Mines will find the way.

This statement will add little to the purely scientific theses covering the facts relating to this bill. This phase of the subject will be adequately presented no doubt by distinguished scientists affiliated with the great petroleum and other affected industries, from members of the faculties of higher institutions of learning, from engineers and from the personnel of the Bureau of Mines who have broad experience and knowledge as to the relative petroleum and coal reserves of the Nation, and who are well versed in all phases of organic chemistry.

These men, all of them, will stress the progress made in foreign countries, notably Germany and England, in the manufacture of gasoline from coal and the advancement in various developments of coal research and technology. Such progress has been marked, despite the fact that we have not yet started on the chemistry of coal. The making of coal from vegetable matter is essentially a process of dehydration. We have not yet learned to reverse this process, but we shall. Coal chemistry needs fresh original minds with a new approach. As a matter of fact, all of us should go to work on this problem of producing synthetic liquid fuels from coal and other sources—the Government, through the Bureau of Mines and the

Department of Agriculture, organizations sponsored by the various States, industry, and our universities and colleges.

There are many sound reasons why the Government, through the Bureau of Mines, should undertake the work provided in this bill. The best reason is that it is necessary from the standpoint of the public interest. When, as has been pointed out by eminent authority, the ratio of 1942 output of petroleum to known reserves is 1 to 14, whereas the ratio of 1942 output of coal to known reserves is 1 to 3,830, the necessity for research in the conversion of "coal and other substances" to synthetic liquid fuels is alarmingly apparent. While presently the case of gasoline from coal is not a complete parallel to that of synthetic rubber, it may conceivably so develop in another 15 years. When the processes of manufacture of synthetic rubber were described about 16 years ago at an International Conference on Bituminous Coal in this country, only a cursory interest was manifested. No one now doubts our woeful lack of foresight.

It is my personal opinion that it is a waste of time and energy to argue this question from the standpoint of the economics involved. If responsible sources tell us, and they have, that there is a chance that we may have a serious shortage of petroleum in the United States in less than 20 years, we should not lose 1 minutes to begin research work in an effort to develop some method of furnishing gasoline and other oils, and in ample quantity. Our national safety can conceivably in time become dependent upon what is done in connection with this bill.

The history of the marvelous growth of the oil industry in this country is the history of men who had the courage to take a chance. Pratt in his illuminating book, "Oil in the Earth," takes the position that had prospectors for oil in other countries, whose geology is as good or better than ours, taken the chance that American prospectors took through the years, their growth might, area considered, have equaled or surpassed that of this country. It is Mr. Pratt's judgment that good chances still exist in this country, but the point I am striving to make is that we are staking our all on the chance. By all means take chances but in addition throw around our national well-being every conceivable factor of safety.

When our own supply of petroleum becomes exhausted we can, as the Secretary of the Interior argued in his article, *Coal's New Horizons*, obtained it in "one or two ways or a combination of both." And those two ways are importation and hydrogenation. We have recently learned in a manner we should never forget, not to depend on importation.

The fundamental reason for doing the job which this bill proposes is that it is necessary. Here are some other sound reasons which bear on the necessity:

(1) The use of the internal combustion engine for air, land, and water transportation will continue to grow rapidly after the war.

(2) Petroleum products (gasoline, Diesel fuel, and so forth) from whatever sources derived (crude oil or coal or oil shale) will therefore be in constant and increasing demand, even though alcohol may also be used to some extent.

(3) The rate of discovery of new oil fields in the United States is slowing down, and we shall have difficulty in supplying ourselves, much less sending petroleum to other countries to use in their rapidly growing transportation systems.

(4) Whether new large oil fields will be discovered in new countries, Arctic Canada and Russia, Central Africa, Australia, and South America, we do not know. It is not safe for us to depend on them in any event.

(5) Petroleum products can be made from coal, and our coal supplies are so large we need not worry about the next several hundred years. Germany and England are successfully making gasoline this way on a large scale.

(6) It is true that the cost is higher than for gasoline from natural oil but this fuel as it leaves the refinery in America is an extraordinarily cheap material. Taxes, transportation, and handling really make up the retail price, and these would be no higher for synthetic gasoline.

(7) Just as different methods of refining and reacting give us special gasolines and other natural fuels, so will different procedures in manufacturing hydrocarbons from coal produce special types of liquid fuel, perhaps better than any known now, and different coals will result in different end products.

There is no question about the coal reserves of this country for the next several hundred years. We may safely discount the 3,380 years of reserves of coal in the United States, based on the 1942 production, to one-fourth of this total, as a margin of safety, and thereby eliminate any element of chance.

In other words, here is a known process for the manufacture of gasoline which can be improved upon by the scientists of this country together with the Bureau of Mines.

In Alabama, which produces only about 6 percent of the total annual production of the Nation's coal, the reserves of coal were estimated in 1920 by Marius R. Campbell of the United States Geological Survey to be 65 billion tons. At the highest annual rate of production these reserves would have a life of over 3,000 years. Likewise, if these figures were discounted and one-fourth of the estimated reserves taken as a basis, the life of the Alabama coal fields would be 750 years using the highest known annual production as a divisor.

While we are discussing Alabama, your attention is directed to the fact that of the coals thus far tested by the United States Bureau of Mines east of the Rocky Mountains, the highest yield in gallons of gasoline per ton of coal was from the Black Creek bed in Alabama, which yield was 134 gallons per ton. The second highest yield was 130 gallons, the next 126; then followed coals producing 122, 112, and 105 gallons per ton of coal, respectively.

Recently drilled holes to this Black Creek bed in Alabama indicated an ash of only 1.60 percent. This point is emphasized here because, generally speaking, the lower the ash in a coal the higher the yield in gasoline and, more important some view it, the more easily the coal will dissolve.

This matter of solvents for coal under pressure is becoming increasingly important. As far back as 1938, one of the large industrial concerns in Germany initiated this method of producing high-grade, light motor fuel, Diesel oil, and fuel oil. It is altogether likely that

after the war there will be many illuminating revelations emanating from Germany as to improvements in this process.

While we do not press the point, we respectfully suggest that since this bill contemplates the erection of research plants, that Alabama be given adequate consideration in the final determination as to location.

It is imperative, in the broad approach to this question of government experimentation in the production of liquid fuels from coal, that there be the utmost cooperation between industry and the Government. All shadow of suspicion should be removed.

In the article, Coal's New Horizons, by Secretary Ickes, to which previous reference has been made, there is this statement:

If this research is to be of any value, it must be carried on in a full-scale demonstration-type commercial pilot plant.

Then, under section 3 of the act there is provided a method of disposing of this gasoline by sale. And while the section sets out that the Secretary of the Interior shall give first priority in the sale of the product of this plant to the War and Navy Departments, then to any department, agency, or other instrumentality of the Federal or State Governments, any remaining portions may then be disposed of elsewhere at the prevailing prices.

It will be conceded that with the relatively small amount of gasoline which can be produced in any ordinary experimental pilot plant and with the great demand from the Army and the Navy and other governmental agencies, there is little likelihood, under any strict interpretation of the proposed bill, that the Government would enter the gasoline business; nevertheless there is such a possibility under this act and that possibility should be removed. It is suggested that in the enactment clause the word "demonstration" be changed to "experimental"—not because of any degree of difference in the definitions of the two words, but because by common usage the word "experimental" more properly describes the type of plant herein contemplated. It is further suggested that the provisions of section 3 previously referred to should be amended to assure industry that the United States Government will not enter into competition with it in the production of gasoline, motor fuels, or other lubricants.

It has been recommended that the experiments not be carried any further than the production of a basic liquid, leaving the matter of the refining to the petroleum industry. This procedure has my approval. Even though there be some disagreement as to competition from the Government, it must be conceded that as far as experimentation goes there is no need to carry the process of producing such liquid fuels beyond the basic liquid stage. The refining capacity of the United States is adequate and could be made available for the refinement of these liquids.

There is not much option on the part of the Congress of the United States in its action on this bill because of the principles involved. There is so much at stake. It is so essential from the standpoint of the public welfare that there should be no question whatsoever concerning its approval by this Committee and its adoption by the Congress.

This statement is signed by Milton H. Fies, who is vice president of the DeBardeleben Coal Corporation; graduate mining engineer,

Columbia University; Doctor of Science, University of Alabama; president, Southern Association of Science and Industry; trustee, Alabama Research Institute; and member, Technical Advisory Board and Mining Committee of Bituminous Coal Research, Inc., Alabama Academy of Science, American Association for the Advancement of Science, and American Institute of Mining and Metallurgical Engineers.

Senator O'MAHONEY. Well, I am very glad to assure you, sir, as the sponsor of the bill, that there is no intention to set the Government up as a competitor with what we ordinarily call private industry, but as indicated in the questions directed to Secretary Ickes this morning, to enable the Government to become a pioneer in a field which apparently has not yet been thoroughly explored.

Are there any questions to be asked of the witness? If not, we are very grateful to you, Mr. DeBardeleben.

Mr. DEBARDELEBEN. Thank you, gentlemen.

Senator O'MAHONEY. Is Mr. Battle present?

Mr. BATTLE. Yes, sir.

STATEMENT OF JOHN D. BATTLE, EXECUTIVE SECRETARY, NATIONAL COAL ASSOCIATION, WASHINGTON, D. C.

Mr. BATTLE. I have a very brief statement.

My name is John D. Battle. I am executive secretary of the National Coal Association with headquarters in the Southern Building, Washington, D. C. This organization is the representative of the bituminous coal producers throughout the United States and represents the producers with respect to general policy matters.

Senator O'MAHONEY. How many members are there in the Association, Mr. Battle?

Mr. BATTLE. There are some 900 members, but several thousand mines.

Senator O'MAHONEY. You have kept an office in Washington for some time?

Mr. BATTLE. Twenty-six years, since its formation.

Senator O'MAHONEY. How large a force do you have?

Mr. BATTLE. About 25 people.

I wish to make a few remarks with respect to S. 1243, the purpose of which is to construct and operate demonstration plants to produce synthetic liquid fuels from coal and other substances. Without burdening the record with figures, let it suffice to say that there is an ample supply of bituminous coal stored away in the earth to take care of all our requirements in this country for many hundreds of years. It is true that there are certain types of coals that do not have a very long life but by and large there is an ample supply of coal to meet all the needs of the Nation for a longer period of time than I would care to speculate.

It is, of course, the desire of the producers of bituminous coal that as great a quantity of coal be produced as is necessary to meet the needs of the Nation, whether it be for use directly or for conversion into other products. We approve of the idea of the Government engaging in experimental and demonstrative studies to the extent of

building a pilot plant or plants necessary to prove the feasibility of abstracting oil and other fuels from coal. We think it entirely proper that the Government undertake research work of the character proposed and there is no better group in the Government than the United States Bureau of Mines to carry on this work. We in the coal industry have the highest regard for that organization and feel that a good job will be done under its direction.

I appreciate the remarks that you just made a few minutes ago to Mr. DeBardeleben, and that bears on my next few remarks.

In the interests of free enterprise I call attention to the fact that our endorsement does not go beyond experiment and demonstration. We do not feel that it is wise for Government to enter into the business of selling products even though they may be sold at cost or at a so-called going price. We feel that Government responsibility in the matter should cease with the demonstration that abstraction of liquid fuels from coal is practicable and feasible. Once this is proven, we feel that private industry should take over from that point. I believe private industry will take over at that point.

We feel that the plant or plants should be confined solely to the liquefying process without the necessity of Government going further into the refining business. It must be kept in mind that if the supply of oil in this country is becoming scarce, as we are told, there may eventually be a surplus of refining capacity, and certainly additional refining capacity should not be built with the funds of the taxpayers as long as there is sufficient capacity owned by private industry. We suggest that it would be well to develop carefully this phase of the problem, and confine the activities of the Federal Government to the main point of proving the feasibility of synthetic liquid fuels from coal and other substances.

I repeat that it is not the function of Government to engage in business per se, and even under present conditions there is scarcely any sound reason, in our opinion, for that sort of thing. We think the bill before you goes too far in that respect. I hope the Government will prove the process and engage in the experiments and I suggest that this legislation be amended or clarified so that the Government would not find itself engaging in the business of selling a finished product because necessarily it would have to be sold in competition with other liquids of similar value and this is not a proper function of government.

Senator O'MAHONEY. In what respects do you think it goes too far?

Mr. BATTLE. About selling the products.

Senator O'MAHONEY. What do you think the Government should do; give it away after it is made?

Mr. BATTLE. Not necessarily give it away, but if it is a pilot plant I think that would remove the possibility of any supplying of the market.

Senator O'MAHONEY. I may say to you that the Bureau has already been confronted by this problem in the manufacture of certain metals from critical and strategic minerals, which are needed for the war. There is no legal authority now existing for the Bureau to dispose of material which it has produced, and it was deemed at least in the interests of economy in government that provision should be made

here for the sale of whatever is produced, but I say again that it was not the thought of those who worked on the preparation of this bill to set the Government up in competition with private industry.

For myself, I may say that I feel that the ideal situation is one in which the largest number of persons and of private organizations are enabled to operate themselves in every branch of trade and commerce.

The restriction of private enterprise, however, in the past, has been quite as effectively brought about by monopoly as it has been by Government, and I think we need fear a good deal more monopolistic restrictions than Government restrictions of private enterprise.

MR. BATTLE. Well, I hope that you are correct and I know that you are sound in your views in that respect, and it was just the cautious businessman's warning.

It is unfortunate that the bituminous coal industry is not in a financial position to carry out the development of these experiments itself, but the fact remains that it is in no position at this time to build plants of this nature. No effort will be made here to go into the technicalities of the problem. It is policy that we are concerned with at this time and we leave to the technicians the method of research and so forth.

We do fully recognize the need for a greater quantity of oil and further recognize that coal perhaps furnishes one of the best, if not the best, method for securing synthetic oils. With these limitations, and suggestions with respect to the policy involved, we endorse the passage of this bill and pledge the cooperation of the coal industry in the experimental work.

Thank you very much, sir.

Senator O'MAHONEY. Are there any questions?

Congressman RANDOLPH. Mr. Battle, you have said that the coal industry is not able to work on the scale required to carry forward this sort of experimental work, and certainly that is perfectly well known by the committee and those who have studied the extent to which it is necessary to carry forward such a program. Have you a fear of the nationalization of the coal-mining industry within the past few months?

MR. BATTLE. Yes; we have had some apprehension, let's put it that way, along that line. It is hard to put your finger on them, but the trend of things has looked a little bit in that direction to some of us.

Congressman RANDOLPH. You felt that even the temporary order of Secretary Ickes in taking over the mines might lead to such a condition?

MR. BATTLE. We felt so in some respects. We hardly felt that the coal industry should be penalized for something that it did not bring upon itself, from the operators' standpoint, at least.

Congressman RANDOLPH. I am not attempting to divert the testimony here, but I am so interested in the subject matter because West Virginia is the largest producer of bituminous coal, and in my own district of 15 counties 9 of them are coal-producing, and I have been worried somewhat myself by the possible nationalization of the coal industry, and I was fearful of its effect on the actual program which we have carried forward through the years.

I am not thinking now of any disputes between operators and mining unions, but I am thinking simply of the over-all picture of the private

enterprise of this country coming into competition with federalization or nationalization, because if it extends to the coal industry it could very quickly extend to the oil industry and then to other industries as well.

Mr. BATTLE. You are entirely correct. I said we have had those apprehensions. However, we are working very nicely with the departments and I don't know that there is any one individual that is specifically out to do that. But the circumstances have just been a little bit unfavorable and they have had us a little bit apprehensive that those things might come about, which we think would be one of the most disastrous things that ever happened in this Nation.

Congressman RANDOLPH. Now, the carrying forward of the provisions of Senator O'Mahoney's bill, which you have endorsed, would in no wise be any entering wedge in this picture which you have feared might be coming?

Mr. BATTLE. I don't think so at all. I think as long as we keep it on an experimental basis, and in the very competent hands of the Bureau of Mines, that we need have no fear of that.

Congressman RANDOLPH. You have confidence in the Bureau of Mines?

Mr. BATTLE. Absolutely.

Congressman RANDOLPH. I think that has been commented on by most all of the witnesses who have appeared, and that it helps Senator O'Mahoney's bill to have it administered by that agency.

Mr. BATTLE. I think there is no question about that.

Senator O'MAHONEY. Are there any other questions? If not, thank you very much, Mr. Battle.

Mr. BATTLE. Thank you.

Senator O'MAHONEY. The next witness is Mr. William B. Heroy.

STATEMENT OF WILLIAM B. HEROY, DIRECTOR OF RESERVES, PETROLEUM ADMINISTRATION FOR WAR

Mr. HEROY. Mr. Chairman and members of the committee, my name is William B. Heroy, and I am Director of Reserves in the Petroleum Administration for War.

I have prepared a rather extended discussion, Mr. Chairman, of the supply of crude petroleum within the United States. The hour is a bit late. I can summarize this and make it perhaps a little less extended than the paper, which I will put in the record with your permission.

Senator O'MAHONEY. That will be quite satisfactory.

Mr. HEROY. The first part of the paper is devoted to a brief discussion of the growth of the the demand for petroleum and motor fuel, pointing out the greatness of the national appetite for those commodities which has grown through the years, and pointing out also that our people have become accustomed to having unlimited amounts of motor fuel, and we don't ever think, ordinarily, of economies in that direction.

Senator GURNEY. Had unlimited amounts prior to this emergency period?

Mr. HEROY. Oh, yes.

Senator GURNEY. Right now I am sure they haven't got enough.

Mr. HEROY. Right now I am sure that in some places they will not have enough to satisfy what they wish to use.

Senator GURNEY. In all places.

Mr. HEROY. Yes. This thing has come about rather suddenly. I think up to the beginning of the war there was no question on the part of anybody connected with the industry that we wouldn't be able to meet almost any demand for motor fuel.

I then propose to reexamine the present position in the light of what we know now about our petroleum reserves. The total reserves of the United States are estimated at the present time at about 20,000,000,000 barrels. I try to visualize that by saying that if the District of Columbia were a tank 50 feet high, those reserves would just about fill the tank. It is a very large amount of oil.

The past production of the United States up to the present time is even more than that, something like 25,000,000,000 barrels, as you know.

I have prepared several charts which I think you may have before you there, gentlemen, which illustrate this matter of petroleum reserves.

The first chart, No. 1, is a historical chart based on the estimates of reserves of the American Petroleum Institute. It shows the reserves which they have estimated, the proven reserves, as of the end of each year. It shows also the amount of reserves which have been added each year to the previous estimate, and that additional estimate is divided so as to show the additional reserves which come about through extensions and additions of previously known fields, and reserves in fields which are newly discovered during that year.

In other words, if we look at the black column at the bottom of the chart, that is the reserve at the beginning of the year. The portion with the horizontal lines is the amount that was added during the year by revision of previous estimates. The vertical lines show the amount of oil that was added by new discoveries. That brings the column up to the top. Then we have on the right-hand side of each a stippled area, which is a debit amount representing the amount of oil taken out of the ground each year. So that we again start with the black column the next year as our new balance.

Now, if I have made that clear, you can see what has happened to our reserves from 1937 to 1943, or rather to our estimates of reserves. We have increased the total proven reserves each year but you will note that the increment each year is getting smaller and smaller, both as to revisions and extensions, and as to the amounts discovered, and I think those two dotted lines indicate very fairly the trend.

Now that figure is based on an annual inventory taken at the end of each year, and I would like to go from that to the next figure which takes the subject up, on a somewhat different basis.

This figure 2 is based on the taking for each year of the oil fields that were discovered in that year, looking back into history, and taking the total as we now know it, of the reserves of all the fields that were found in that year. In other words, if there were a certain number of fields found in 1918, we now know, looking in retrospect, how much oil that was. We can estimate, of course, a 1918 discovery very closely now.

So we have set out on this second chart a comparison of the reserves found in each year as we now know them, in comparison with the United States consumption.

Now you can see by the chart that there were several periods in here when we did quite well on discovery. One period climaxed in 1921; 1930, of course, the tallest line on the chart, was the year when the East Texas field was discovered. Then we come over to a period of very good hunting, between 1934 and 1938, when, in each of those years, the amount of oil discovered was substantially in excess of the domestic consumption.

Now, beginning with 1939, however, you will notice that in each year from 1939 to 1942 we have, according to our best estimates, discovered substantially less oil than we have consumed.

Now, I would like to present that to you in the form of another chart which is like the first chart——

Senator O'MAHONEY (interposing). Before you leave this chart, Mr. Heroy, this indicates that from 1936 on we have annually consumed more than 1,000,000,000 barrels of oil?

Mr. HEROY. That is right, sir, up to about 1,400,000,000 barrels.

Senator O'MAHONEY. The consumption in 1941 and 1942 approximated about 1,400,000,000?

Mr. HEROY. That is right.

Senator O'MAHONEY. That is barrels?

Mr. HEROY. Yes.

Senator O'MAHONEY. Do you have any reason to believe that the rate of consumption will decrease in the future?

Mr. HEROY. Do you mean in the immediate future, that is within the term of 10 or 15 years, or something of that sort?

Senator O'MAHONEY. That is right.

Mr. HEROY. I have no reason to think so; no, sir.

Senator O'MAHONEY. I am asking that question merely to throw additional light upon the assumption that was made by Mr. Russell in discussing his charts, and which he himself said he didn't believe in, namely that the rate of consumption would not increase.

Senator GURNEY. Well, of course we will not be using up as much in our war effort, and you might touch on that as to whether or not increased civilian consumption will equal what we hope to——

Senator O'MAHONEY (interposing). Of course when the war is over there will be a decrease in consumption for war purposes, I am not thinking of that. I am thinking of the normal consumption of oil in American industry.

Mr. HEROY. You are thinking of the normal consumption in the post-war period?

Senator O'MAHONEY. Right.

Mr. HEROY. We have at the present time something like 130,000,000 people in the country and we have, I suppose, something like 30,000,000 motor vehicles, which is 1 motor vehicle per something over every 4 people. I think there is a limit to the number of cars that that number of people can drive. It may be that we will increase that ratio somewhat, but I don't think a great deal, and I think that the increase in the number of motor vehicles in the future is more likely to depend upon the increase in our population, rather than on a higher number of

vehicles or number of people per vehicle. I think we have approximately reached the saturation point on the number of motor vehicles.

Congressman RANDOLPH. With our present road system?

Mr. HEROY. Yes.

Congressman RANDOLPH. What about the development of express roads throughout the country, coastwise?

Mr. HEROY. I think even then, Congressman, that there is a limit to the number of miles a person can take the time to drive in a day.

Senator O'MAHONEY. What about aviation?

Mr. HEROY. That is another factor.

Senator O'MAHONEY. Now what is your conclusion——

Mr. HEROY (interposing). I think we are going to use more gasoline than in the past, but I don't think the rate of increase is going to be a straight uphill increase indefinitely.

Senator O'MAHONEY. Your judgment is that the rate of consumption is going to continue to increase for some years to come?

Mr. HEROY. I think that is true, although I do not think that the rate of increase will be as great as it has been in the past.

Congressman RANDOLPH. But the production; what about it, in this post-war period?

Mr. HEROY. I was going to enter into a discussion of that in a moment.

This third chart sets out the discoveries by years in the same manner that chart 1 did, starting with the year 1928 and running through the year 1943. We have estimated, for each of these years, the amount of oil discovered in that year, and have set against that the production for that year. So that this is a measure of the increase of our underground reserves of petroleum from 1928 to 1943.

Senator O'MAHONEY. Before you proceed with that, Mr. Heroy, may I return to the other chart for just a moment?

Mr. HEROY. Yes, sir.

Senator O'MAHONEY. That ends as of 1942?

Mr. HEROY. That is right.

Senator O'MAHONEY. I understand that the figures for 1943, according to the Oil & Gas Journal, show still another decline in discoveries?

Mr. HEROY. That is correct; I was noticing those figures yesterday. Of course, it is a little difficult at this short notice, I mean so soon after the close of the first half of the year, to make an intelligent appraisal of what the fields discovered in the first half of the year are going to do. Some of those fields have, of course, only one or two wells in them, and their size is not as yet fully determined.

Senator O'MAHONEY. Mr. Schneider, of the Department of Justice, who is thoroughly familiar with this oil problem, tells me that according to the Oil & Gas Journal only 437,000,000 barrels were discovered in the first 6 months of 1943, whereas 709,000,000 barrels were produced, making a net reduction in reserves of almost 300,000,000 barrels?

Mr. HEROY. That is about the proportion that has held during the last 3 or 4 years. We have discovered only about 60 percent as much oil as we have produced.

Senator GURNEY. Sixty percent?

Mr. HEROY. Yes, sir.

Senator GURNEY. Well, your chart here in 1942 shows about 20 percent?

Mr. HEROY. I was taking the 4-year period, Senator, over that 4-year period.

Senator GURNEY. All right.

Senator O'MAHONEY. You may proceed.

Mr. HEROY. On figure 3 you will notice again the great build-up of reserves in 1930, due to the finding of the East Texas field, and from then on a gradual climb through the years 1934 to 1938, inclusive, to the high point at the beginning of 1939, and from that point on, the total underground reserve has been decreased because of the excess of production over the reserves discovered.

Senator O'MAHONEY. Well, this chart shows the circumstance to which I referred.

Mr. HEROY. Yes; this is the cumulative chart which brings that out, I think.

Senator O'MAHONEY. I see.

Senator GURNEY. Your chart shows here only a total in reserves of a little over 9½ billion barrels?

Mr. HEROY. Yes, sir; I should have referred to that. The base line at the bottom of the chart corresponds to the reserves as of January 1, 1928, and that increase is the amount since that date only. We don't have as good figures back of 1928 to make this continuous.

Senator GURNEY. I wanted to point out that it didn't agree with the estimate of 20,000,000,000 barrels as reserve.

Mr. HEROY. That is right. We would have to consider this base line as of January 1, 1928, as approximately 11,000,000,000 barrels, and then that would bring this up to about the right figure.

Senator GURNEY. I see. Thank you.

Mr. HEROY. The next point which I might discuss is the trend of exploratory drilling during the last few years. In spite of the fact that these new discoveries have fallen off, the efforts of the industry to find new oil have been substantially increased.

The number of geophysical crews, which is one of our best measures of the exploratory effort, has gradually increased. Around 1937 there were about 200 crews in the field, and at the present time this number has increased to approximately 350, which is the maximum for all time.

So that the effort of the industry, as far as finding oil is concerned, has been consistently increased, although the tendency to find the oil has decreased.

The same thing is true also of the number of wildcat wells drilled. In 1937, 2,224 wildcat wells were drilled and in 1941, 3,264. So you see that there has been a very definite increase in wildcat drillings, although the discoveries have fallen off.

Senator O'MAHONEY. Do you think that we can stimulate that wildcat drilling to any great extent?

Mr. HEROY. Are there ways in which it can be stimulated?

Senator O'MAHONEY. Do you think it can be stimulated?

Mr. HEROY. I think it can; yes, sir.

Senator O'MAHONEY. In what way?

Mr. HEROY. I think that the rate of wildcat drilling can be stimulated by urging the industry to drill all the best prospects that it has

and put as much of its budget money into the drilling as it possibly can, and I think if we can bring to bear on the situation other economic incentives, such as an increase in price, such as a bonus for production on new wildcat wells, all of those factors will tend to increase the rate of wildcat drilling.

Congressman RANDOLPH. May I follow through on that question of Senator O'Mahoney's on wildcat drilling to say that during the past year there was an attempt to reopen certain old fields with wildcat drilling in the State of West Virginia by going to greater depths.

The M. L. Benedum interests spent approximately \$1,000,000 in test wells, seven of them, and also in the acquisition of large acreage. They were unable to develop a single well that would be a producer, and I think that the oil people are generally agreed that West Virginia, a one-time great oil-producing State, is absolutely depleted from the standpoint of any wildcatting which would develop new fields. I think that is somewhat the picture as we take in an over-all view of the United States.

Senator O'MAHONEY. Does the State of West Virginia do anything to arouse interest in oil exploration?

Congressman RANDOLPH. Yes; our State geologist, Mr. Price, has attempted to bring to bear such elements as he can in that direction, but we haven't spent any actual State money in drilling test wells.

In connection with this wildcatting program which occurred on the eastern slope of the Ohio River, I think we should bear in mind that it was absolutely private capital, without a cent of Federal subsidy, and \$1,000,000 was spent in the hope of that man and his associates of developing resources which might have helped in this eastern shortage.

So I pay a tribute to that type of oil industry which, even in the face of expensive costs, and with little hope of finding reserves, went out in the State of West Virginia in this period of just a few months past and actually attempted that. I think we must not overlook the great contribution of men who have not only some dollars but certainly have some courage and some real patriotism, and they haven't asked the Government to step in and do the job for them.

Senator O'MAHONEY. In view of the fact, as was developed this morning for this record, and as we all know, that the Office of Price Administration has declined to approve the recommendation of P. A. W. for an increase in the price of crude oil, I wonder if it wouldn't be a good plan to consider formal legislation on the bonus plan for new discoveries; namely, to provide by law, at least so far as the public domain is concerned, and perhaps generally, that the Government should, during the period of the war at least, pay a certain bonus to be properly determined, for the discovery of new deposits?

Mr. HEROY. I think that question should have been addressed to either Mr. Ickes or Mr. Davies, Senator.

Senator O'MAHONEY. Well, I address it to you because you, in answer to one of my questions, referred to the bonus.

Mr. HEROY. The bonus that I referred to was a bonus of additional allowable for discovery wells, and not a financial bonus for production. Several of the States have now, by regulation, made provision for the increase in the allowable of oil for a discovery well, of several times the amount that would be normally allowed to the ordinary producing well in the field.

Senator O'MAHONEY. Has that been done in Texas?

Mr. HEROY. Yes; and it has been done in California and is now under consideration in Oklahoma, whereby a discovery well for a certain period of time would be given a much larger allowable than normally. That was the bonus incentive to which I referred.

Now as to the other question which you asked, our office has, in replying to Mr. Prentiss Brown, taken the position that a bonus for new discoveries would not be workable. They have recommended against a Federal bonus for new discoveries and for increasing the production of oil.

Senator O'MAHONEY. Why do you not believe it would be workable?

Mr. HEROY. Well, the administrative difficulties would be very serious, Senator, to administer a situation of that kind. As you realize, there are 400,000 producing wells in the United States, and to work out rules and regulations to apportion the bonus equitably among that number of producers, would be quite a problem.

Congressman RANDOLPH. The Federal Government during World War I had a plan for the production of crude oil; would you state for the record what that was?

Mr. HEROY. I don't recall that.

Congressman RANDOLPH. I think we ought to put that into the record. I know it in a general way, but I think some of the witnesses at later hearings should develop it.

Senator O'MAHONEY. Yes.

Senator GURNEY. Your statements have occasioned a couple of questions. First you say that Texas and California have allowed them to pump more from each well than they were heretofore allowed.

Mr. HEROY. As to discovery wells.

Senator GURNEY. Never in any case, I expect, have they allowed them to increase the production to the extent where they might cut down the final total take from that well; in other words, they aren't allowing them to pump it too fast, are they?

Mr. HEROY. No sir; they are not allowing the rate of production to be excessive, but in areas where production is prorated, it is possible, by making an allowance on a discovery well, to make it possible for the man who drills the well to get his money back much more quickly than he would otherwise.

Senator GURNEY. That is fine. Do you know why they are not considering it in the State of Kansas, or why they haven't hurried up and done the same thing in Louisiana, Oklahoma, and Kansas?

Mr. HEROY. No, sir; I do not. I can't give you a good answer to that question.

Senator GURNEY. Is that a matter for the State to handle?

Mr. HEROY. That is a matter for each State to handle.

Senator GURNEY. I see.

Mr. HEROY. We have suggested it in New Mexico, but I think they have not as yet taken action on it in that State.

Senator GURNEY. Let me ask you this. You said we had how many new wildcat wells in 1941?

Mr. HEROY. The number was 3,264.

Senator GURNEY. And what other year did you quote?

Mr. HEROY. I quoted 1937, with 2,224.

Senator GURNEY. Still, with a 50 percent increase in the number of wells during that 4-year period, or 5-year period, they still didn't discover as much oil in 1941 as in 1937?

Mr. HEROY. That is correct.

Senator GURNEY. Well, then, doesn't it follow that no matter how much of an inducement we give these wildcat drillers, still, if they didn't find oil it would eventually just make it impossible for us to wildcat any more?

Mr. HEROY. I think that is another way of saying that the odds against discovery are increasing.

Senator O'MAHONEY. But the odds aren't great enough as yet to stop wildcatting?

Mr. HEROY. That is right, but the odds against it are increasing. I think that is brought out by the table which is on the top of page 6 of this statement.

I have there brought together some figures, showing for the years 1936 to 1942 the number of new fields that were reported discovered, as compared with the petroleum reserves of those fields, that is the total new reserves discovered in each year. By dividing the first figure into the second, we arrive at the volume of petroleum reserves found in each field, and the number has decreased from an average of 14,000,000 barrels per field in 1936, down to something like 1,450,000 barrels per field in 1942.

Senator GURNEY. When you say "field" that is a kind of expanding or contracting unit; is it not?

Mr. HEROY. Yes sir; we have taken the figures reported at the end of each year by the Oil Weekly. Their count as to the number of fields discovered each year we have thought was a fairly consistent statement of it, and we have used that as a basis.

We all appreciate that as time goes on fields sometimes are merged by intermediate drilling. What is sometimes reported at the beginning of the year as a new field dies out because the adjoining wells prove unsuccessful. But on the average I think those factors will cancel out, and those were the best figures that we could obtain to use for that comparison.

The trends revealed by these figures—the increasing number of new fields found and the decreasing volume of reserves per field—are susceptible of only one reasonable explanation, that the size of the newly discovered fields has been progressively decreasing. This conclusion is supported not only by such statistical evidence but by careful study and observation of many individual fields.

How can this trend toward more and smaller fields be explained? No complete or conclusive answer can be offered in the light of present knowledge. Some of the factors which enter into the problem are the following:

During the last 10 years the technical energy of the industry has been chiefly directed toward finding geophysical prospects. A large number of such prospects have been found and control of the lands upon which they are located has been obtained. The areas where these methods are effective have been surveyed and resurveyed, each successive search being more intensive and detailed. It is logical to believe that this constant combing should have found the more obvious structures and that those remaining undiscovered can be

resolved only with increasing difficulty. While it is not always true that the larger and more prominent structures have on them the largest oil fields, there is a general parallel between these two characteristics. Some small and poorly defined structures may prove to have much more important fields than was anticipated. But the tendency is in the other direction. Many companies, active in prospecting, are saying that they are running out of worth-while prospects. On the whole, it is difficult to escape the conclusion that in areas where geophysical (particularly seismograph) methods have been highly effective, the prominent structures have been found and only areas of slight or obscure closure remain undetected.

Senator O'MAHONEY. May I interrupt, Mr. Heroy, to ask to what extent the major oil companies are prospecting or developing their reserves? Now as a preliminary, let me say that the testimony before the Temporary National Economic Committee a few years ago was to the effect that more than 80 percent of the known reserves in the United States were owned by the major companies.

Mr. HEROY. I think that figure is too high.

Senator O'MAHONEY. You do?

Mr. HEROY. Yes, sir.

Senator O'MAHONEY. Well, I think the authority for that statement was Mr. Farish.

Mr. HEROY. I think it would be too high at the present time. My recollection of Mr. Farish's figure was 60 percent, but probably you are right.

Senator O'MAHONEY. Well, it may be that, quoting from memory, I have exaggerated it a little. Let's take it as 60 percent. Are those 60 percent of the reserves being developed now?

Mr. HEROY. I think that the development of the proven reserves is going on about equally as between the major oil companies and the smaller producers. I don't think there is any essential difference in the amount of development that is being done at the present time as between those two groups. The materials are being made equally available to both groups by the War Production Board.

Senator O'MAHONEY. How about the nonproven reserves, that is to say, the prospective oil lands which are held by the oil companies?

Mr. HEROY. As between the development that is being made by the major companies and by others?

Senator O'MAHONEY. Yes.

Mr. HEROY. I don't recall the figure, Senator, as to the number of wildcat wells drilled the last year by major oil companies as contrasted with smaller oil companies, but I can put that figure in the record; I can supply that for you.

(See supplemental statement at conclusion of Mr. Heroy's statement.)

Senator O'MAHONEY. I think it might be helpful.

Mr. HEROY. Very well.

Because of the effectiveness of the geophysical attack in many areas the industry has naturally, in the search for new reserves, largely concentrated in recent years on the use of geophysical methods, and other methods have been subordinated. Geological talent has been largely devoted to the interpretation of geophysical results and such interpretation has tended to monopolize the energies of geological

staffs. Consequently, studies of stratigraphy and historical geology, which are essential to the finding of nonstructural traps have, on the whole, been neglected.

As some of the largest oil fields found in the past are of nonstructural types, it is logical to expect that more such fields will be found if the hunting is properly planned. On the other side of the picture is the fact that random wildcatting should, on the law of averages, have been more successful in finding such fields in recent years if the number remaining to be found is relatively large. Recent discoveries are, however, overwhelmingly of the structural type.

In some areas where structural traps occur geophysical methods are ineffective and prospecting must be carried forward either by structural core-drilling or by carefully controlled wildcatting. Michigan is an example of an area where such conditions are present. The finding of structures in such regions usually proceeds cautiously and, where test wells have to be drilled to depths of several thousand feet, cost is a deterrent or may be even a prohibitive factor under present conditions.

The most disturbing explanation is that, in certain areas, the law of diminishing returns is becoming operative; I think this reaches your point, Senator—that the number of fields remaining to be found in them is less than the number already found, and that those remaining to be found will not be large. As new oil fields are not being formed and as the number is ultimately finite, the time will come sooner or later when the supply is exhausted. Some areas have been so intensively explored and so thoroughly drilled down to the bottom of the sedimentary section that it is difficult to see how important fields have been overlooked. In contrast, large areas of sedimentary rocks remain which have been explored to only a limited extent and where important fields may be expected. Deeper geological systems of rocks lying below unconformities are difficult to explore but will beyond question contain large oil fields when their prospecting is seriously undertaken.

This discussion of the philosophy of oil finding and its prospects for future success could be greatly expanded without reaching conclusions to which no one would take exception. There are all shades of opinion among geologists and informed executives as to the future of our oil supply. The more optimistic see vast areas which have been inadequately explored, in which much oil remains to be found. Others, who are under the necessity of maintaining the reserves of their organizations, are finding it increasingly difficult to find first-class prospects. The facts do not warrant a defeatist attitude of mind but they call for a realistic recognition of the true situation. Oil exploration in the United States will inevitably become more expensive and will require considerably more technical manpower, especially in fundamental geological studies. Some new oil-finding method more effective than those now in use may be developed which would operate to find quickly a new batch of fields. But each successive application of a new and more efficient method has made the remaining fields more difficult to capture.

The public and the industry should realize that the bonanza days of oil discovery, for the most part, belong to history. The finding of oil should henceforth be regarded as a stable industrial function

to be guided by the highest technical skill and administered with efficiency and vision.

That concludes my statement.

Senator O'MAHONEY. Are there any questions?

Congressman RANDOLPH. Yes; I have one.

You disagree with Mr. Russell, then, about the oil discoveries which we can expect in the future?

Mr. HEROY. I wasn't able to hear Mr. Russell's testimony very well, Congressman, and I am not sure just what was his expression of opinion on that point.

Senator O'MAHONEY. Are there any other questions? If not, thank you very much, Mr. Heroy.

(The complete statement of Mr. Heroy is as follows:)

THE SUPPLY OF CRUDE PETROLEUM WITHIN THE UNITED STATES¹

(By William B. Heroy, Director of Reserves, Petroleum Administration for War)

Probably the most important single factor affecting a decision as to the desirability of undertaking the construction and operation of plants for the production of synthetic liquid fuels is the sufficiency of our present dominant source of such fuels, crude petroleum.

On the basis of very large resources of this mineral fuel, the United States has created an economy of industry and transportation unapproached in any other part of the world. From a consumption of about three gallons of crude petroleum per capita in 1900, the consumption has increased to about 425 gallons per capita 40 years later. Most of the consumption in 1940 was as motor fuel, chiefly for vehicles, amounting to about 180 gallons per capita. Approximately 30,000,000 motor vehicles consumed in that year an average of 835 gallons in driving an average mileage of about 9,000 miles. About 75 percent of the motor fuel was used in passenger cars, with 1 car to every 5 of the population.

The Nation has also rapidly become air-minded, with about 17,000 private planes and 450 commercial planes in use in 1940. But consumption of aviation gasoline was, before the present war, still insignificant as compared with that of other motor fuel, being only about 2 gallons per capita.

But, great as was the Nation's pre-war motor fuel demand, it still accounted for only about 45 percent of the total consumption of crude petroleum. Over 40 percent of the products obtained from crude petroleum were burned to produce heat, the per capita consumption being over 140 gallons.

The purpose of this brief summary of petroleum consumption is to show how great the national appetite has become for these commodities. The average citizen has taken it for granted that he would always have available an abundant supply of gasoline for his car and heating oil for his house. For the most part he has given little, if any, concern to problems of supply—he left that to the oil companies. The price of motor fuel, even including taxes that often exceeded the value of the product, was still so low that it was no deterrent to practically unlimited use. The sale of motor fuel was promoted by its marketers by every form of advertising and service. It should be no cause for surprise if, even in the midst of a life-and-death struggle for survival, many of our people are still unable to realize that supplies of petroleum products are not unlimited and that civilian uses must be reduced.

If it had not been for the war, with the sudden demand for unprecedented quantities of petroleum products, it is doubtful if anyone, outside of a few economists and geologists with a speculative turn of mind, would have given much thought to the sufficiency of petroleum supplies. In the pre-war years the industry had developed most ingenious and effective methods of oil finding. The annual inventories of proven underground reserves had shown regular and substantial increases. Reports of wildcat drilling showed in successive years gratifying increases in the number of successful wells. Most of the larger oil companies had acquired ample reserves; in 1939, 20 major companies owned about

¹ Presented in connection with S. 1243, authorizing the Government to build and operate demonstration plants for producing gasoline and fuels from coal, natural gas, oil shales, etc.

57 percent of the proved reserves. In the hearings held the previous year by the Temporary National Economic Committee, I have found no suggestion that the reserve position was not then considered entirely satisfactory. Mr. W. S. Farish in his summary statement said, "The rate of increase in reserves since 1924 has been adequate, in spite of large requirements; on the other hand, it has not been so rapid as to disturb the balance of the industry." Up to the commencement of the war no question was raised as to the adequacy of petroleum supplies and the industry and the Government entered the war with full confidence in the soundness of the petroleum position.

It is now intended to reexamine that position in the light of present knowledge.

I. PETROLEUM RESERVES

The proved petroleum reserves of the United States are currently estimated at over 20,000,000,000 barrels. We may visualize this quantity by saying that if the District of Columbia, with its 73 square miles, were a tank 50 feet deep it would be filled by this amount of oil.

Our knowledge of petroleum reserves prior to 1925 is quite meager but there had been in previous years fairly close balance between reserves and production. In the succeeding period of 7 years, 1925-31, the volume of new reserves discovered substantially exceeded production. The discovery of the East Texas field in 1930 made available an immense reserve and the ensuing rapid development of that field overshadowed all other development activities for several years. In 1932 and 1933, in part due to general economic conditions and in part due to the concentration of development in East Texas, the reserves of new fields discovered were less than the volume of oil produced.

With the year 1934, however, a new cycle of discovery was initiated. Among the causes for this increased stimulation of oil finding were doubtless the regulation of market demand, the control of interstate shipments, and the improvement of geophysical methods. During the 5-year period 1934-38, discoveries of new reserves substantially exceeded production.

Commencing with 1936, systematic and regular estimates of proved petroleum reserves have been made by a committee of the American Petroleum Institute. The results of these annual appraisals are shown graphically on the accompanying chart (fig. 1). Each year the Institute committee revises its figures, taking into account the additional information obtained through new developments. Immediately after a field is discovered its proved reserve will be small and this will be increased in later years by extensions. New pools may later be discovered in the same field, which will increase its reserves. As a result of this method of appraisal the increase in reserves shown for each year consists chiefly of extensions and revisions rather than of additions by the discovery of entirely new fields.

The chart shows that since 1937 the proved reserves have been increased each year. The total amount of proved reserves added by extensions, revisions, and new discoveries from January 1, 1937, to January 1, 1943, was 14,916,007,000 barrels. The production for the same period was 7,896,614,000 barrels, so that the apparent increase in reserves over that period was 7,019,393,000 barrels. The inference that would normally be drawn from these figures would be that nearly twice as much oil had been added to reserves as was produced and that, after production had been taken care of, there remained to add to the reserves nearly as much oil as was produced.

A closer inspection of the chart shows that, while the reserves were apparently increased in each year, the amount of annual increase has been, in general, decreasing. The volume added each year by new discoveries also shows a tendency to decrease. The result is a falling off in additions to reserves in recent years. This tendency is made evident by the flattening of the trend lines shown on the chart.

Another approach to this problem of the reserve position is by consideration of discovery. Each oil field has a birthday, the date of completion of the discovery well. With the successful completion of such a well the work of exploration has achieved its principal purpose and the work of development of the field is begun. It is, of course, true that the completion of the discovery well usually proves only a limited volume of reserves and that the completion of each succeeding well yields information upon which the reserve figures may be revised. In the course of development the field may be greatly extended and new pools may be added by deeper drilling. But while such development may

**PETROLEUM ADMINISTRATION FOR WAR
DIVISION OF RESERVES
HISTORY OF PETROLEUM RESERVES 1937-1942**

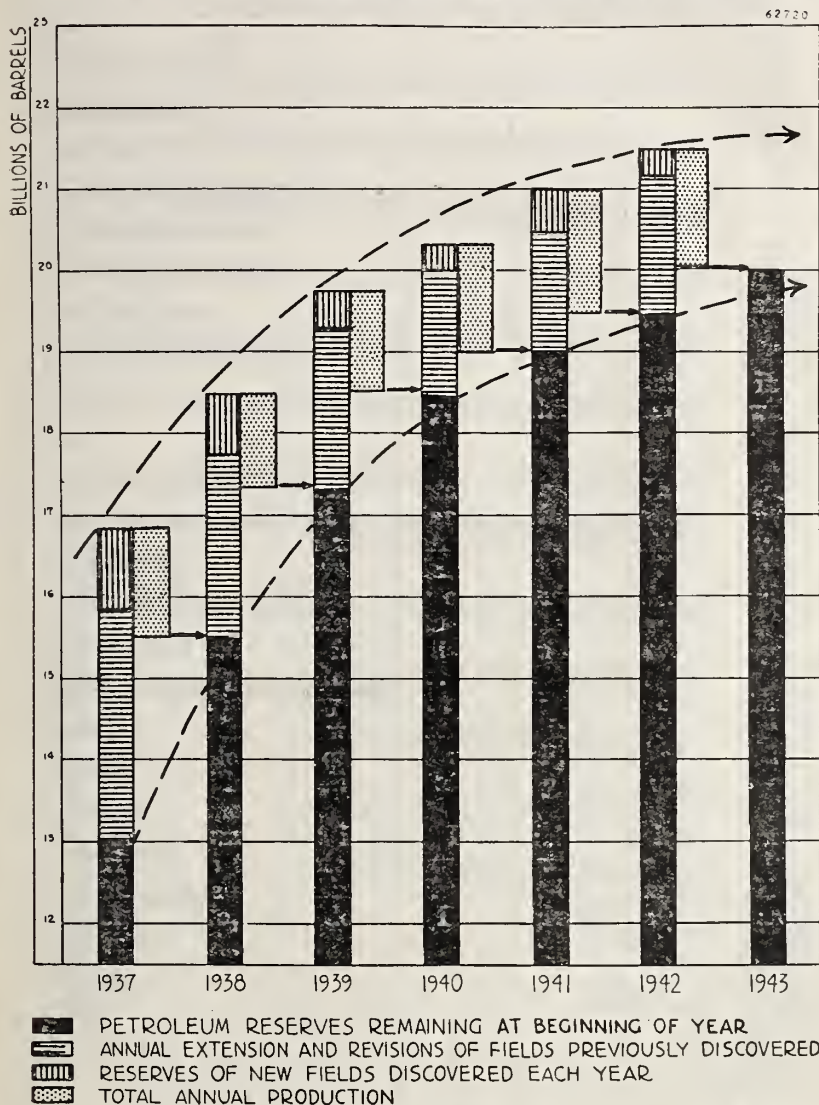


FIGURE 1.

API DATA

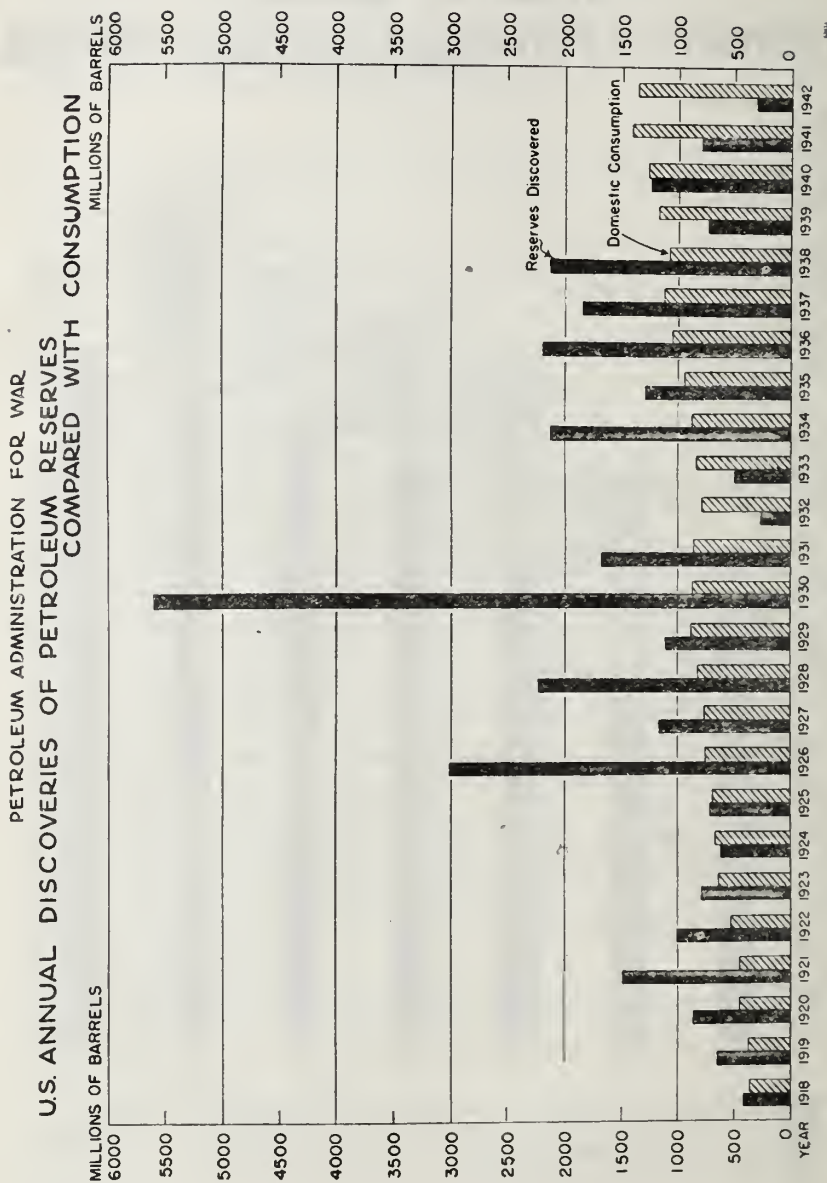
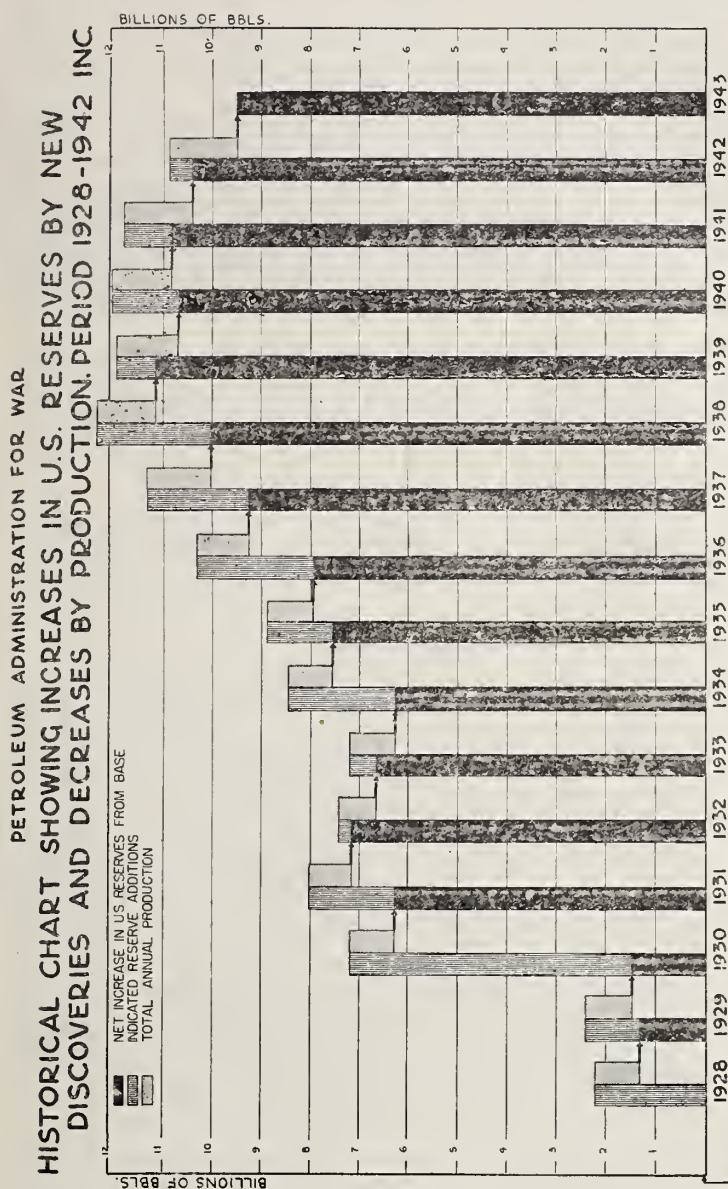


Figure 2.



Base line corresponds to Reserves as of Jan. 1, 1928.
Indicated possible maximum Reserves of known fields and pools are used as a basis.
Reserve additions are based on estimates as of Jan. 1, 1943

FIGURE 3.

afford a basis for upward revisions of proven reserves from year to year, it does not alter the fact that the field was found by the first discovery.

It is therefore possible, in the light of present knowledge, to determine in what year each field was discovered, and to appraise the original reserve of oil present in it. By combining the figures of oil fields discovered in each year a total can be computed of the reserves found. In order to see what the trend of discovery has been in recent years, a study has been made of the reserves of fields discovered in each year commencing with 1918. The results of this analysis are shown on a second chart (figure 2) which compares proved reserves found in each year with the domestic consumption of petroleum.

The recent history of reserves is, I believe, even better illustrated by another chart (figure 3) which shows discoveries for the years 1928 to 1942, inclusive, on the basis of the possible maximum reserves of each field discovered. This includes not only the proved reserves but also the additional reserves that are considered possibly present on the basis of geological information. In the cases of older fields where the reserves are quite definitely determined, such geological additions would be small or none, but in the cases of more recent fields which are not fully developed these additions may be substantial, even much larger than the proved reserve. The reason for adopting this basis is so that recently discovered fields will be placed as nearly as possible on the same footing as older fields.

The base line of the chart was taken as January 1, 1928. Examination of the chart shows that the year 1930, in which the east Texas field was discovered, was the year of greatest discovery. In the years 1932 and 1933 the figures show that production substantially exceeded discovery. In the period 1934-38, discoveries exceeded production to the extent of about 4,900,000,000 barrels. But the following 4 years, 1939-42, the trend was again reversed and production exceeded reserves discovered to the extent of about 1,650,000,000 barrels.

While, therefore, the annual inventory of the American Petroleum Institute indicates that total proven reserves have been increased each year of the last 4 years, this is true only from an appraisal standpoint. From the standpoint of discovery, reserves have declined during that period, having reached their highest level at the beginning of 1939. This decrease in reserves is at the foundation of our present concern as to oil supply.

II. THE DISCOVERY RATE

The decrease in the volume of new reserves discovered in the years 1938-42 occurred during a period of increasing demand for and consumption of petroleum and its products. The only previous reversal of trend recorded in the history of the industry in this century was that in the period of 1932-33, when consumption was substantially reduced by industrial depression. The recent change of trend is not readily explained by economic factors.

The discovery of a new oil field may be the result of drilling wells at random, or may be the result of extensive or intensive scientific investigation. In the early history of the industry practically all discoveries resulted from random wildcatting. In later years the proportion of wildcat wells located on a technical basis has gradually increased. According to Dr. F. H. Lahee's statistics, in the period 1937-41, 67 percent of the wildcat wells in the 11 principal productive States were located on a technical basis.

During recent years the reflection seismograph has become the most widely used method for finding areas favorable for prospecting. Commencing about 1930, the number of seismograph crews in use has steadily increased. The average number of crews operated in 1937 was 192, and in 1942, 233. Other methods of prospecting increased the total number of crews in 1937 to 256, and in 1942 to 316. The employment of petroleum geologists has also increased steadily in recent years. It is apparent, therefore, that there has been at no time in recent years any slackening of consequence in the scientific effort to discover new oil fields.

The trend of exploratory drilling has also been consistently upward. In 1937, 2,224 wildcat wells (again using Dr. Lahee's figures) were completed, and in 1941 the number was 3,264. The number declined to 3,212 in 1942, but this was primarily due to difficulties with material and manpower. The decrease in the discovery rate cannot be attributed to any decline in the volume of exploratory drilling.

Two factors enter into the rate of discovery of new reserves. One is the number of new discoveries made and the other is the magnitude of the dis-

covery. In the analysis of the number and size of new discoveries certain difficulties are encountered. Out of the total number of wells reported each year as discovery wells a proportion, perhaps a third, do not, as a result of subsequent development, prove to be field openers. Some of these wells decline rapidly in production and offsetting wells fail to produce. It frequently happens that wells reported as discovery wells are not far from previously producing areas and that the new and old production is connected by later drilling so as to become a single field. By this process of merger the fields discovered in earlier years tend to become larger. Deeper drilling and the discovery of deeper pools also operate to increase the total reserves attributed to older fields. In the more recently discovered fields the possibilities of production from deeper formations are not so likely to be tested as in older fields where the structure is generally better known.

These difficulties can be avoided to a large extent by using as a basis of comparison the number of fields reported at the close of each year to have been discovered during that year. Annual figures of fields discovered have been compiled by the Oil Weekly since 1936. If these figures are compared with present estimates of the total reserves of petroleum, proven and possible, discovered in the corresponding year the following results are obtained:

Year	Number of new fields reported	Petroleum reserves discovered proved and possible (thousands of barrels)	Volume of petroleum reserves per field (thousands of barrels)
1936.....	162	2,392,865	14,771
1937.....	221	2,077,220	9,399
1938.....	256	2,298,806	8,980
1939.....	254	816,596	3,215
1940.....	304	1,463,759	4,815
1941.....	341	976,444	2,863
1942.....	348	507,299	1,458

The trends revealed by the above figures—the increasing number of new fields found and the decreasing volume of reserves per field—are susceptible of only one reasonable explanation—that the size of the newly discovered fields has been progressively decreasing. This conclusion is supported not only by such statistical evidence but by careful study and observation of many individual fields.

Another disquieting feature of the situation is that, among all the 1,247 fields reported as discovered in the years 1939–1942, so few should be of large size. Only 3 fields found in that period now appear to have reserves of over 100 million barrels and only 30 have reserves of more than 20 million barrels. The reserves of many of these fields will ultimately be increased by the finding of deeper reservoirs and by extensions not now anticipated; nevertheless, the dearth of large fields scarcely seems accidental.

How can this trend toward more and smaller fields be explained? No complete or conclusive answer can be offered in the light of present knowledge. Some of the factors which enter into the problem are the following:

1. During the last 10 years the technical energy of the industry has been chiefly directed toward finding geophysical prospects. A large number of such prospects have been found and control of the lands upon which they are located has been obtained. The areas where these methods are effective have been surveyed and resurveyed, each successive search being more intensive and detailed. It is logical to believe that this constant combing should have found the more obvious structures and that those remaining undiscovered can be resolved only with increasing difficulty. While it is not always true that the larger and more prominent structures have on them the largest oil fields, there is a general parallel between these two characteristics. Some small and poorly defined structures may prove to have much more important fields than was anticipated. But the tendency is in the other direction. Many companies, active in prospecting, are saying that they are running out of worth-while prospects. On the whole it is difficult to escape the conclusion that, in areas where geophysical (particularly seismograph) methods have been highly effective, the prominent structures have been found and only areas of slight or obscure closure remain undetected. Some favorable areas found and leased in

the past are being held for future testing and are likely, when drilled, to develop large fields. But the policy of hoarding prospects is not a general one in the industry and most companies drill promising areas as soon as they can obtain the necessary control of the lands.

2. Because of the effectiveness of the geophysical attack in many areas the industry has naturally, in the search for new reserves, largely concentrated in recent years on the use of geophysical methods, and other methods have been subordinated. Geological talent has been largely devoted to the interpretation of geophysical results and such interpretation has tended to monopolize the energies of geological staffs. Consequently studies of stratigraphy and historical geology, which are essential to the finding of nonstructural traps, have, on the whole, been neglected.

As some of the largest oil fields found in the past are of nonstructural types, it is logical to expect that more such fields will be found if the hunting is properly planned. On the other side of the picture is the fact that random wildcatting should, on the law of averages, have been more successful in finding such fields in recent years if the number remaining to be found is relatively large. Recent discoveries are, however, overwhelmingly of the structural type.

3. In some areas where structural traps occur geophysical methods are ineffective and prospecting must be carried forward either by structural core drilling or by carefully controlled wildcatting. Michigan is an example of an area where such conditions are present. The finding of structures in such regions usually proceeds cautiously and, where test wells have to be drilled to depths of several thousand feet, cost is a deterrent or may be even a prohibitive factor under present conditions.

4. The most disturbing explanation is that in certain areas the law of diminishing returns is becoming operative; that the number of fields remaining to be found in them is less than the number already found and that those remaining to be found will not be large. As new oil fields are not being formed and as the number is ultimately finite the time will come sooner or later when the supply is exhausted. Some areas have been so intensively explored and so thoroughly drilled down to the bottom of the sedimentary section that it is difficult to see how important fields have been overlooked. In contrast, large areas of sedimentary rocks remain which have been explored to only a limited extent and where important fields may be expected. Deeper geological systems of rocks lying below unconformities are difficult to explore but will beyond question contain large oil fields when their prospecting is seriously undertaken.

This discussion of the philosophy of oil-finding and its prospects for future success could be greatly expanded without reaching conclusions to which no one would take exception. There are all shades of opinion among geologists and informed executives as to the future of our oil supply. The more optimistic see vast areas which have been inadequately explored, in which much oil remains to be found. Others, who are under the necessity of maintaining the reserves of their organizations, are finding it increasingly difficult to find first-class prospects. The facts do not warrant a defeatist attitude of mind, but they call for a realistic recognition of the true situation. Oil exploration in the United States will inevitably become more expensive and will require considerably more technical manpower, especially in fundamental geological studies. Some new oil-finding method more effective than those now in use may be developed which would operate to find quickly a new catch of fields. But each successive application of a new and more efficient method has made the remaining fields more difficult to capture.

The public and the industry should realize that the bonanza days of oil discovery, for the most part, belong to history. The finding of oil should henceforth be regarded as a stable industrial function to be guided by the highest technical skill and administered with efficiency and vision.

(Mr. Heroy subsequently submitted the following letter concerning wildcatting and the statement of W. S. Farish, President of the Standard Oil Co. of New Jersey.)

Hon JOSEPH C. O'MAHONEY,
United States Senate.

MY DEAR SENATOR O'MAHONEY: In the course of my testimony before the War Minerals Subcommittee on Tuesday, August 3, the question was asked concerning the amount of wildcatting done by the larger oil companies.

Using as a basis the 20 companies having the largest production of crude oil, it appears that these companies and their subsidiaries drilled in the year 1942, 722 wildcat wells, or 22.4 percent of the total number of wildcat wells drilled during that year. They also made contributions, through such methods as the farming out of acreage, purchase of acreage spreads, payment of bottom-hole contributions, and payment of dry-hole contributions, to 1,194 additional wells, or 37.1 percent of the wildcats drilled during that year. This makes a total of 59.5 percent of the wildcat wells drilled in 1942 in which these 20 largest companies were interested directly or indirectly.

In the course of my testimony reference was also made to the statement of W. S. Farish, president of Standard Oil Co. (New Jersey), made at the hearings of the Temporary National Economics Committee concerning the proportion of total proven reserves of petroleum held by these companies. Mr. Farish's testimony on this subject occurs in part 17 of the hearings, and I enclose a copy herewith for your convenience.

Independently of Mr. Farish's figures, this office has made a computation of the domestic production and reserves of the 20 United States companies having the largest production, for the years 1938 and 1941, as follows:

	1938	1941
Percent of total production per year.....	49.5	54.9
Percent of total proved reserves, end of year.....	65.6	56.2

I trust that these figures may be of assistance to your committee.

Sincerely yours,

Enclosure

WILLIAM B. HEROY,
Director of Reserves.

STATEMENT OF W. S. FARISH, PRESIDENT, STANDARD OIL CO. (NEW JERSEY) BEFORE
TEMPORARY NATIONAL ECONOMICS COMMITTEE, WASHINGTON, D. C., OCTOBER
23, 1939; HEARINGS, PART 17, PP. 9692-9693

OIL RESERVES

MR. FARISH. The majority of the proved reserves of petroleum in the United States today is owned by the major companies. That is to say, if the reserves of every company which owns as much as 1 percent of the total proved reserves of the Nation are added together, the total will constitute more than half of the proved reserves. The balance of the reserves, something less than half the total, is owned by thousands of small operators. At first sight this fact might be taken to indicate the elimination of the small operator as a competitor in the producing industry. But this would be a mistaken conclusion, as will appear from the facts recited in the succeeding paragraphs. If the 20 largest operators own some 60 percent of the total proved reserves, it merely means that on the average each operator owns about 3 percent. The largest of these companies own only about 10 percent of the total, while the reserves of the smallest company in the list of 20 majors are of the order of 1 percent of the total.

As to the finding experience of small enterprises versus the majors, the estimates of our own engineers afford the following figures on current and recent finding results:

At the end of 1938, our engineers estimated the total proved reserves in the United States at 16.7 billion barrels (an estimate which has since been increased), including California as well as the territory in which our own companies operate. Of this total, the 20 largest producing companies in the business owned 65.26 percent, whereas all other operators owned the balance, 34.74 percent. Of the additional oil proved up in the United States by discoveries, extensions, and revisions of previous estimates in 1938, amounting to a total of about 1,200,000,000 barrels; "net, that is, after the production of the year is taken out," the 20 major companies obtained 600,000,000 barrels, or exactly 50 percent, while all other operators obtained the remaining 50 percent. Thus, the independents improved their position during 1938, the last year for which figures are available. That is to say, the independents, with less than 35 percent of the existing reserves, found or owned 50 percent of the oil that was added to the total supply during that

year. The 20 majors failed to increase their reserves in proportion to their existing ownership.

Senator O'MAHONEY. Mr. Wrather, can you finish this afternoon?

Mr. WRATHER. At your pleasure, Senator. The hour is late, and if you would prefer to carry over until tomorrow, it is agreeable to me.

Senator O'MAHONEY. It is now 5 o'clock. I think the members of the committee would probably prefer to close now, if that is agreeable to you. I was trying to finish with the Geological Survey this afternoon.

Then tomorrow morning we will assemble at 10 o'clock, and you will be the first witness, Mr. Wrather.

The committee stands in recess until 10 o'clock tomorrow morning.

(Whereupon, at 5 p. m., the committee recessed until 10 a. m. Wednesday, August 4, 1943.)

SYNTHETIC LIQUID FUELS

WEDNESDAY, AUGUST 4, 1943

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON
PUBLIC LANDS AND SURVEYS,
Washington, D. C.

The subcommittee met, pursuant to adjournment, at 10 a. m., Senator Joseph C. O'Mahoney (chairman) presiding.

Present: Senators O'Mahoney (chairman), Murdock, Gurney, and Davis.

Also present: Congressmen Randolph, Fenton, Furlong, and Beall.

Senator O'MAHONEY. The committee will come to order, please. The first witness this morning will be Mr. Wrather, head of the Geological Survey.

Would you be good enough to take the stand, Mr. Wrather?

Before you begin, Mr. Wrather, I want to refer to a statement that was made yesterday during the hearing by the Chair with respect to the control of petroleum reserves by the major oil companies. The facts with respect to this were developed at an earlier hearing of this committee in October 1942, and on page 1412 of the hearing there is a table showing the control of proven crude oil reserves of the United States, 1939 to 1942. This table shows that 70 percent of the known reserves are in the hands of the major oil companies. The Chair said yesterday, speaking from recollection, that it was 80 percent, and the witness, W. B. Heroy, said it was 60 percent. I just want to have the record corrected.

Very well, Doctor, we will be glad to hear from you.

STATEMENT OF W. E. WRATHER, DIRECTOR, GEOLOGICAL SURVEY,
DEPARTMENT OF THE INTERIOR

Mr. WRATHER. Mr. Chairman and gentlemen of the committee, attention is here directed toward a proposed plan for the Bureau of Mines of the Department of the Interior to explore the production of synthetic fuels derived from coal, oil, shale, and other organic substances. As insurance for the security of the Nation, the proposal is timely. It should be authorized and pressed strongly. The importance of petroleum and its products has been amply demonstrated throughout two world wars and the quarter of a century intervening. It is imperative that adequate supplies be assured in the future for both wartime and peacetime use.

We have relied in the past on our unusual national wealth of petroleum and natural gas for liquid fuels. This source is, and will remain, adequate for an indefinite and unpredictable time into the

future, but there is unquestionably a limit to the supply of any mineral resource. Unlike the metals, petroleum products once produced and used, are gone forever; there remains no accumulating residue of scrap available for recurring use. The carbon and hydrogen in the primary fuel are of course not destroyed in use, but they are dissipated into the atmosphere through the exhaust from an internal-combustion motor or up the stack from boilers, and are totally irrecoverable.

During the last 85 years the petroleum industry has grown steadily in magnitude and service; it has produced altogether 26,000,000,000 barrels of oil in 23 States and it has met the power demands for our motor vehicles, ships, and airplanes. In recent years petroleum has supplied as much as 34 percent of the total energy derived from mineral fuels in the United States, and natural gas has supplied about 11 percent more. The use of both these fuels has rapidly increased since 1917 when together they supplied only about 14 percent of the fuel energy. For many years the United States has produced and consumed about three-fifths of the world's annual output.

When we entered the present war we complacently assumed that our supplies of crude petroleum were adequate for any emergency—that our chief and only worry might be the problem of distribution or, in other words, transportation. As the war has progressed the demand has increased at an unprecedented rate. Civilian use has been continuously curtailed to divert more and more oil to war use, and yet the demand increases insatiably. The draft on many of our producing oil fields is now heavier than it should be if our chief objective was solely economic and efficient operation. The search for new sources of supply has been greatly accelerated, yet since 1938 there has been an average decline in the annual addition to our reserves. Thus a disconcerting and probably significant element is introduced into the national picture. Once again the specter arises to plague us as to whether we have at last gone “over the top” and are now on the slow decline toward inadequate reserves.

Several times in the recent past this situation seemed to confront us. A few years after the last war both technical men and the public became greatly alarmed at the failure of new discoveries to meet the growing demand. For a brief interval the move to develop alternate supplies of liquid fuel received rather widespread and enthusiastic support. At that time it was thought that our chief reliance lay in oil shales. The Geological Survey set itself to the task of studying the grade and quality of the widespread oil shales of the country, and the estimation of reserves.

The Bureau of Mines and various groups of industry experimented with the recovery of oil from shale, and the processing of the resulting product. Then followed the spectacular discovery in rapid succession of a number of major oil fields. The “heat was off.” In a surprisingly short time complacency once again descended on all concerned, and practically all support for further experimentation was withdrawn. The episode of fear was quickly forgotten, except for the lurking apprehension of a handful of technical men who realized that inevitably the day would arrive when our crude supplies would fail and we would not be ready with a new technology to meet the situation.

There is today a substantial group, not only in the public but including also experienced oil producers, who, having previously heard the cry of "wolf," persist in the belief that we will continue to find new fields indefinitely. They have watched the estimates of reserves made by technical groups and have seen them steadily mount from around 6,000,000,000 barrels to around 20,000,000,000 barrels on a steadily ascending scale. They insist, therefore, that with increased wildcat activity, the present declining trend can and will be arrested. It is worth while accordingly to consider briefly the significance of these reserve figures, which were made by the most competent men then available.

Most of the estimates presumed to forecast merely the amount of oil recoverable from the fields which were known at the time the estimates were made. They were not intended to express the total future supply of the country, both discovered and undiscovered. Sufficient time has now elapsed since the earlier estimates to demonstrate that they were reasonably accurate. Since these early forecasts, an accelerating development program, under geological guidance has resulted in many discoveries of new sources of supply, far more than adequate in the aggregate to meet the current demand.

Accordingly, each new estimate indicated a mounting reserve, but only the reserve which might be produced, under the then existing production methods, from fields known at the time. Much thought has been devoted to estimating reserves and it can now be assumed that present estimates are a reasonably reliable index to the potentialities of known fields. It should be borne in mind that present estimates generally do not include oil to be recovered from these same pools by secondary recovery methods. Undoubtedly the increment to be recovered in this fashion will eventually add considerably to the total.

There remains the all-important question of how much additional oil remains to be discovered, and to that question no definite answer can be given. Geologists can indicate the most favorable locations for oil accumulation, but no method has yet been found to locate the actual oil underground other than the drill.

New fields will unquestionably be brought to light probably with declining frequency, for many years to come. Available techniques are now being utilized to the limit, despite which the trend is toward declining reserves. The Geological Survey has undertaken an expanded program to aid in the selection of areas favorable for oil prospecting. This work should be further expanded and intensified when properly trained manpower is once more available. These studies are being undertaken in full collaboration with petroleum geologists in industry. The geological investigations of Government and industry will supplement each other rather than overlap and duplicate. The staff of the Survey will devote their attention to the broader, fundamental aspects of geology in the various regions studied to make available to industry the requisite background of information on which to predicate its future drilling program.

A new departure in geologic mapping was attempted in 1934 when the Geological Survey prepared a map of the United States showing not only the known oil fields but also areas in which it is possible that more oil fields will be discovered.

Thus far, our rapidly expanding petroleum industry has been sustained in large part by new discoveries. Maps of this character indicate that the areas in which new fields can be discovered, though large, are circumscribed; that the number of new fields must be limited; and that the discovery of each new field leaves one less to be discovered.

Reference was made above to the fact that oil shales were generally considered during the early 1920's to be our chief reliance for a supplemental source of oil products. During the last war German technologists developed a process for converting coal and even inferior grade of lignite to liquid fuels. The news of this process was first received by the public in this country with incredulity. It was considered to be a sort of chemical legerdemain which could scarcely be expected to produce important amounts of liquid fuels at reasonable cost.

Continued experimentation eventually demonstrated the utility of the several processes evolved and henceforth coal supplanted oil shale as the most likely source of liquid fuels. The success of Germany, England, and Japan in producing synthetic fuels from coal during the present war, clearly indicates that we should not delay in perfecting processes adapted to domestic coals of the United States.

The production of liquid oils from coal or oil shale comparable to those derived from crude petroleum should occasion little wonder. The raw materials are all hydrocarbon substances. Geologic evidence indicates preponderantly that all were derived chiefly from living organisms, either plant or animal or both. Compared to normal crude oil, coal contains an excess of carbon; hence to bring it up to the grade of crude oil, hydrogen must be added. Accordingly, the German process is commonly referred to as the "hydrogenation of coal."

Oil shales contain finely comminuted fragments of organic matter, which have apparently been arrested in their conversion by natural distillation to liquid oil. Essentially the problem of producing liquid oil from coal, oil shale, or other solid hydrocarbons, falls into the general pattern of the very flexible chemistry of the hydrocarbon group and the basic processing will be fundamentally related.

If we are eventually to rely on these several collateral sources for a substantial portion of our future oil supply, we should know as accurately as possible the available reserves of usable raw material. Here again we can take great comfort in the huge reserves.

Coal.—Coal supplies more than half of the total energy used annually in the United States, although the rapid increase in the use of petroleum, natural gas, and water power since 1900 have reduced the percentage of energy supplied by coal from about 90 in 1900 to about 52 in 1940. The adequacy of our coal reserves is a matter of great national interest. Fortunately, they can be determined with a relatively high degree of accuracy that is not possible in determining the total resources of petroleum and natural gas. The adequacy of the coal reserves, however, is dependent to a far greater degree on unpredictable future changes and increases in utilization than on

such known factors as present and past rates of production. As the supplies of oil and gas from natural reservoirs diminish, the energy now supplied by both oil and gas will be derived in large part from our great reserves of coal.

Another important factor that may further increase the demands on our coal reserves is the rapid depletion of coal of high rank and quality in many foreign countries which may result in increased exportation of coal from the United States. Therefore, the future demands on our coal reserves are not quantitatively predictable but may well be far greater than the maximum production for any year in the past (678,211,904 net tons in 1918.)

Past and present mining of coal has been chiefly confined to the more easily accessible and higher quality coals. Thus, the percentage depletion of our total coal supply is of less immediate concern than is the much more rapid depletion of our high quality coals, such as the coals of the East that are suitable for metallurgical coke.

It is increasingly apparent that the economy of any nation's mineral resources must be considered in the light of world supplies and world distribution. The United States, including Alaska, possesses more than half of the known total coal of the world. According to the latest estimates the world's supplies of coal are distributed as follows:

Percentage of coal reserves of the world by countries

United States, including Alaska.....	51.9
Canada.....	16.7
China.....	13.5
Germany.....	5.7
Great Britain and Ireland.....	2.6
Siberia.....	2.3
Australia.....	2.2
Other countries.....	5.1

It is necessary to know also how much of each kind of coal we originally had, how much has been used, and what reserves are still available. The latest estimate made by the Geological Survey shows that only a comparatively small percentage of our coal has been used.

	<i>Percent</i>
Anthracite coal available at end of 1936.....	70.54
Bituminous coal available at end of 1936.....	98.11
Subbituminous coal available at end of 1936.....	99.93
Lignite available at end of 1936.....	99.98

In estimating the reserves of ultimately available coal it was assumed that the minimum thickness of bituminous and anthracite ever likely to be mined was 14 inches and that the minimum thicknesses of subbituminous coal and lignite would be, respectively, 2 and 3 feet. The maximum depth from which coal is likely to be recovered was placed at 3,000 feet. This was based on the mining practice in countries where coal is scarce today and where coal is already being mined from depths as great as 3,500 feet. It is significant that comparatively little of our coal lies at depths greater than 3,000 feet.

Available coal resources of the United States

State	Anthracite coal	Bituminous coal	Subbituminous coal	Lignite
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
Alabama		66,627,383,000		
Arizona and California				
Idaho and Oregon		692,120,000	1,753,228,000	
Arkansas	222,695,000	1,293,088,000		
Colorado	91,405,000	212,617,050,000	104,049,972,000	
Georgia		916,295,000		
Illinois		197,794,658,000		
Indiana		51,973,927,000		
Iowa		28,692,767,000		
Kansas		29,653,642,000		
Kentucky		121,546,161,000		
Maryland		7,677,918,000		
Michigan		1,933,607,000		
Missouri		83,681,170,000		
Montana		2,609,060,000	62,850,218,000	315,473,043,000
New Mexico	66,000	18,810,479,000	1,862,703,000	
North Carolina		66,135,000		
North Dakota				599,945,525,000
Ohio		91,960,301,000		
Oklahoma		54,755,583,000		
Pennsylvania	14,589,460,000	103,300,820,000		
South Dakota				1,019,628,000
Tennessee		25,289,831,000		
Texas		7,984,076,000		22,928,747,000
Utah		87,976,203,000	5,152,409,000	
Virginia	488,976,000	20,646,578,000		
Washington		11,250,150,000	52,416,321,000	
West Virginia		147,748,138,000		
Wyoming		30,310,881,000	589,999,043,000	
Total	15,392,602,000	1,407,808,021,000	818,083,894,000	939,366,943,000

If coal should be called upon at some time in the future to supply the demands now met by oil and gas, the coal reserves of the United States, assuming a 30-percent loss of coal in mining, would last about 2,000 years at the 1910 rate of consumption of energy from mineral fuels (24,475 trillion B. t. u.).

The greater part of the coal resources of the Nation are in the West, and the deposits there of anthracite, bituminous coal, subbituminous coal, and lignite have scarcely been touched when their limited development is compared with the rapid depletion of the high-quality coals of the East. The coals of the West thus properly join the western oil shales in inviting experimentation and development for the production of petroleum substitutes.

Senator O'MAHONEY. It is altogether possible that the deposits in Siberia are much greater than we now know.

Mr. WRATHER. I think they are, probably; yes, sir.

Senator O'MAHONEY. Is not it the best geological opinion that Siberia is a vast unmeasured storehouse of natural resources of all kinds?

Mr. WRATHER. I think that is true. It has coal, iron, many of the metals and nonmetals also. In fact, there have been more new discoveries, I imagine, in Siberia, if we knew the facts, than in any other part of the world in the recent past.

Now, with regard to the oil shales, the Geological Survey has estimated that price permitting, approximately 92,000,000,000 barrels of crude oil is recoverable from oil-shale deposits of the United States. This is approximately double the sum of all the oil produced to date, plus the present estimated reserve. Of this estimated quantity 75,000,000,000 barrels lie in oil shales of Tertiary age that crop out chiefly in northwestern Colorado and northeastern Utah and subordinately in Wyoming and Nevada. The estimated total quantity includes also approximately 17,000,000,000 barrels believed to be recov-

able from black shales of Devonian age in Indiana and Kentucky. Since those estimates were made (1928), apparently large additional deposits of oil shale of Ordovician age have come to light through exploratory surveys in Nevada. It is germane to point out here that in order to use this great potential resource of mineral fuel it would be necessary to establish a mining industry comparable to the bituminous coal-mining industry at its peak of productivity during the last World War.

Before the waning of the intense interest in oil shale following World War I the Geological Survey had mapped in more or less detail all the known large deposits of oil shale in the Rocky Mountain region and many of the smaller deposits. The estimates of reserves are based almost wholly on the Survey's field investigations.

One far-sighted and beneficial result of the intense activity in oil shale in the years following World War I was the withdrawal by the Government and segregation of two large tracts of the richest oil-shale land, one in Colorado and one in Utah, as naval petroleum reserves. The selection and boundaries of these tracts were based upon the Geological Survey's field data.

Senator O'MAHONEY. Have you had an opportunity to look into the tests that were made in the Rocky Mountains in 1926?

Mr. WRATHER. I am not any too familiar with them in detail, Senator. I know the Bureau did considerable testing. There developed difficulties in mining. For instance, the very rich oil shales are tough; they do not shatter with explosives. There are also difficulties in retorting on account of gumming and caking of the oil shale. If we go into the oil shale as a source of available supply, it will undoubtedly mean the establishment of a mining industry comparable to the coal-mining industry. I think there is a great deal to be known about oil shales that can only be found out by experimenting.

I hope this proposed plant will help to clarify the picture as to how much of these fuel reserves can be made available for use to the public.

Senator O'MAHONEY. Your opinion is that the experimentation contemplated in this bill is really necessary?

Mr. WRATHER. I think it is. Before we can get any idea as to how important this reserve may be, obviously we must find out, from the best tests we can make, how much of it can be made available as fuel.

Natural gas has in recent years been an increasingly important source of the lighter liquid fuels. In the light of recent improvements in technique, it is not unreasonable to believe that considerably larger percentages of natural gas will eventually be converted to a liquid state. In view of this potentiality it would be more reasonable to carry our estimates of natural gas in terms of tons rather than cubic feet. If this possibility materializes, natural gas reserves will assume a far greater importance in our domestic economy than they now carry. It is appropriate, therefore, that some attention be given to natural gas reserves in the present connection.

Commercial production of natural gas in the United States started in Fredonia, N. Y., about 1820, when gas from a shallow well was supplied through a lead pipe to 30 domestic burners. In 1872 a wooden pipe line was constructed from West Bloomfield, N. Y., to Rochester, N. Y., a distance of 25 miles. Now, about 100,000 miles of trunk lines

are required to transport gas from fields in 27 States to consuming centers in 35 States. Consumption of gas has mounted rapidly to 3 trillion (thousand billion) cubic feet a year.

About half of the gas reserves of the United States have practically the same geographic distribution as the oil reserves. This is so because approximately half of the natural gas is produced with oil; the gas is, in fact, the source of energy which brings the oil to the surface. Gas, however, is found in many areas that do not produce oil, and also greater quantities of gas are now being found with the oil that is discovered and produced from progressively greater depths.

The latest estimate of our known natural-gas reserves made by the Geological Survey (1939) is of the order of a hundred trillion cubic feet or more. In terms of the present high rate of utilization this is more than 30 years' supply.

I imagine if that figure were revised to date it would probably be 125 trillion cubic feet.

Senator O'MAHONEY. Are there any questions, Congressman Randolph?

Congressman RANDOLPH. I think that there is one question. I would like for the witness to develop this a little further. I am wondering whether he believes it is more to the interest of the public welfare to use this natural gas which we now have to make gasoline and certain fuel oils, or to use it for the purpose that it is now used; that is, to light our homes and to fire our furnaces in many parts of the country, and also to heat building establishments.

Mr. WRATHER. I have a very decided personal opinion about that, and that is that the present use of natural gas for fuel for heating and in boilers is extremely wasteful. I have a feeling, as time goes on, we will prize our natural-gas reserves more and more. As indicated by Mr. Russell and others, it will probably be possible to convert a higher percentage of gas to liquid fuel. There is a high percentage of methane, CH_4 , in natural gas, which is considered to be one of the most stable fractions and one of the most difficult to break down.

In other words, has a rigid or chemical bond, and is extremely difficult to crack. Since methane is 90 percent or better of most gases the liquid fuels we have recovered from this source in the past have come from the remaining ten percent.

Oil chemists have persisted in the hope of eventually solving this problem of making methane perhaps available for conversion.

Congressman RANDOLPH. If I may interject, Mr. Chairman, at this point, I am certainly in agreement with the witness as to the wastefulness of which he speaks. I remember from personal experience in the West Virginia gas fields years ago, I remember as a boy riding through the countryside and seeing tremendous jets of gas used to light large areas, and I am told that that was a tremendous waste, at least you could see it was. That was happening with thousands of jets which were left burning night and day.

Senator O'MAHONEY. You mean jets of natural gas?

Congressman RANDOLPH. Jets of natural gas, yes; thousands of them. That occurred all over the United States for a period of a quarter of a century at least.

What do you think now about our gas reserves in this country? Would you comment further upon what you actually believe our gas reserves to be, that is, natural gas?

Mr. WRATHER. I do not care to say further, Mr. Randolph, than about 100 trillion cubic feet. The figure is changing very rapidly with the drilling to increasing depths, and we find more and more reserves. There has been an accelerating rate of discovery of gas reserves with the deeper drilling. Wells 2 miles deep are not unusual by any means. There is a substantial production from below 10,000 feet at the present time, and with the deeper oil there occurs usually a larger volume of gas.

Congressman RANDOLPH. Your pressure increases with the depth; is that true?

Mr. WRATHER. Yes.

Congressman RANDOLPH. In what States particularly are we finding these deposits in deeper sands?

Mr. WRATHER. Principally in the Southwest and in California.

Congressman RANDOLPH. In the Southwest and California?

Mr. WRATHER. Yes; Louisiana, Texas, and California, and also to a lesser degree in other States.

Senator O'MAHONEY. Are those discoveries being protected against the sort of waste to which the Congressman referred?

Mr. WRATHER. I think they are. I think there has been in the oil business in recent years a greater effort toward conservation. The excuse for the wastage in the past, to which Mr. Randolph has referred, has been the expense of gathering system that would bring the gas in from the various jets.

Senator O'MAHONEY. What is that system?

Mr. WRATHER. The wastage of gas that Congressman Randolph referred to from burning gas jets around the fields—really, in most cases there is not a large volume of gas escaping at any one jet, but the expense of establishing gathering lines and bringing the converging stream of gas into market has always been a problem.

At present there is a growing conviction that gas should be trapped and returned to the reservoir. I would say there is a constantly improving technique tending toward better conservation.

Senator O'MAHONEY. Is there any difference in the treatment of this problem on the public domain and elsewhere?

Mr. WRATHER. Not to my knowledge, sir.

Senator GURNEY. Mr. Wrather, can you tell me what you think as to how long our natural-gas supply would last if we had to depend on natural gas entirely for our motor fuels?

Mr. WRATHER. I am afraid I am unable to answer that question, Senator Gurney.

Senator GURNEY. You have the number of trillion cubic feet.

Mr. WRATHER. We can estimate the number of trillion cubic feet, but when it comes to the conversion of natural gas to liquid fuel, I would be reluctant to express an opinion, because I really do not know enough about the subject. My interest is chiefly in the raw.

Senator GURNEY. In your opinion, should we turn first to natural gas after our crude petroleum supply is exhausted?

Mr. WRATHER. I would think, before that time, we would have to rely on subsidiary sources, for instance, hydrogenation of coal as a collateral source.

Senator GURNEY. Would the hydrogenation of gas come before hydrogenation of our coal?

Mr. WRATHER. It would depend on the volume that might be expected from that source. I would say that natural gas would scarcely meet our entire need at a given time.

I think the demand is too great to be realized from the treatment of gas alone.

Senator GURNEY. If and when we do run out of crude petroleum, we will have to use not only gas but also coal?

Mr. WRATHER. And several others also.

Senator GURNEY. And coal?

Mr. WRATHER. Yes; coal.

Senator GURNEY. Alcohol and what not?

Mr. WRATHER. When you deal with coal, you are dealing with fossil plant growth.

When you deal with alcohol it can be derived from growing plants. They all constitute one chemical family, oil shale, coal, growing vegetation, petroleum.

The great preponderance of evidence is that they are derived, all of them, from organic sources. The chemistry of hydrocarbons is an extremely flexible chemistry. You can do all kinds of tricks with it.

The further we go the more things we find out can be done with them. There is a fundamental similarity in the whole family, all of these substances we have been talking about, oil shale, coal, natural gas, petroleum, and so forth.

Senator GURNEY. Thank you.

Senator O'MAHONEY. Any questions, Senator Murdock?

Senator MURDOCK. Nothing.

Senator O'MAHONEY. Dr. Sayers?

Dr. SAYERS. No.

Senator O'MAHONEY. We are very grateful to you, Mr. Wrather.

Mr. WRATHER. Thank you, Senator.

Senator O'MAHONEY. Mr. Brown.

STATEMENT OF BRUCE K. BROWN, ASSISTANT DEPUTY PETROLEUM ADMINISTRATOR FOR WAR

Mr. BROWN. My name is Bruce K. Brown. I am Assistant Deputy Administrator under Mr. Davies in the Petroleum Administration.

It is now apparent to everyone concerned with the problem of supply, distribution, and use of petroleum or its products that there is a threatened shortage of this highly necessary commodity. Not only do we depend upon petroleum as a source of fuel for our fighting planes, motorcars, trucks, as well as industrial and domestic fuels, but it is also necessary for the manufacture of the major part of our toluene supplies for high explosives and butadiene for our synthetic rubber program. Plastics, synthetic resins, and organic chemical derivatives generally are also being made in ever-increasing quantities from petroleum and natural gas.

Petroleum may be looked upon not only as a critically necessary material for military uses, but, on account of the tremendous quantities required and the direct combat use made of it in modern warfare, it may be termed a supercritical material. For example, petroleum and its products comprised more than 50 percent of the shipments of war materials employed in the battle for Africa. While it is

not expected that synthetic liquid fuels will play a major role in the present war, it appears to be a matter of good judgment and insurance in view of our experience in raising productibility of synthetic rubber, and metals such as magnesium, aluminum, and steel to start immediately to provide for the future. Our American civilization has been built upon a basis involving adequate supplies of petroleum, but it is a fact, nevertheless, that we are faced at present with a situation wherein our petroleum supplies will last only a relatively few years. It is the better part of good judgment to begin to insure our future supplies of liquid fuels now.

Crude oil and natural gasoline are produced and consumed at a rate estimated at more than 1,400,000,000 barrels per year, whereas our known crude oil reserves are only approximately 20,000,000,000 barrels. Our present rate of production exceeds the rate of new discoveries several fold and this situation has existed for the past 5 years.

For example, last year the rate of discovery of new fields and extension of old fields was only 60 percent of production during the same period. Based on present information with regard to our proved reserves and the rate of consumption and production, estimates with regard to the length of time which our petroleum supplies will last are as low as 14 years and, with present techniques of finding oil, the life expectancy of our petroleum supplies barely exceeds 20 years. However, it cannot all be produced in this time for the most efficient production, which means that we shall have to resort to imports to meet our requirements. To complete the picture of our natural-fuel resources: at the present rate of production of 3 trillion cubic feet per year our natural-gas reserves of about one hundred trillion cubic feet will last in the order of only 30 years.

On the other hand, our oil shale deposits will produce an estimated 92 billion barrels of oil, and our coal deposits which are our largest single natural-fuel resource in round figures amount to an estimated three thousand billion tons.

It is apparent that coal is the principal source of our fuel supplies for the future, and it is quite certain that with the necessary development there is sufficient coal available to supply both our liquid and solid fuel needs for more than a thousand years.

Fortunately, the technical and scientific requirements for the production of synthetic liquid fuels from coal and natural gas have been prepared and the ground work is laid for the rapid development of commercial processes leading to the production of practically unlimited supplies of liquid fuels from our resources of greatest abundance, namely coal, oil shales, and natural gas.

PRINCIPAL PROCESSES FOR THE PRODUCTION OF SYNTHETIC FUELS

There are two principal processes for the production of synthetic fuels from coal and natural gas. One of these is the Bergius process, which was developed to a commercial stage by the I. G. Farbenindustrie in Germany and which comprises direct hydrogenation of coal or preferably mixtures thereof with hydrocarbons, to motor fuel and intermediate products. Commercial production by this process began in Germany in 1926 and has increased to an estimated production of approximately 95,000 barrels or more of gasoline per day. The

Imperial Chemical Industries at Billingham, England, built and operated a similar direct coal hydrogenation plant, having a capacity of 3,500 barrels of gasoline per day.

The second process, known as the indirect process, is that of Fischer-Tropsch, wherein coal, lignite, or natural gas is first converted to water gas, or more specifically a mixture of carbon monoxide and hydrogen and then the mixture of gases in proper proportions is passed over a catalyst at relatively low pressures (1 to 10 atmospheres) and temperatures preferably of the order of 350° to 400° F. to produce gasoline, Diesel oil, waxes, and other products.

The Fischer-Tropsch process has also been developed in Germany with four installations, having a total estimated capacity of about 7,000 barrels of gasoline per day in 1940, which from information received by us has been increased severalfold since.

Senator O'MAHONEY. Were both of these processes commercially developed in Germany?

Mr. BROWN. Yes, sir.

Senator O'MAHONEY. You spoke of the Bergius process. By that do you mean that the fuel oil could be produced and sold profitably?

Mr. BROWN. No, sir. Both of these processes were well on the way toward commercial development before the advent of Hitler and that national economy which disregarded economics and avoided importations.

Both processes were developed prior to that time, but the greatest commercial development in Germany occurred after the advent of the Nazi Party when they desired to quit importations in which they paid no attention to what we would regard as economics.

Let me put it this way: Gasoline or other petroleum products could not have been made in Germany and exported to the rest of the world, it would not have paid, the cost was much too high, but it was an internal cost.

Congressman RANDOLPH. May I interrupt at that point? Is it not true that certain of the conquered countries had been used by the Nazis to step up the production of gasoline for the war machine of Hitler?

Mr. BROWN. Yes; I believe there were some such installations in the conquered countries for the same reason, for national welfare. They had no adequate supply of petroleum and they were anxious to reduce importations and become self-sufficient.

Senator O'MAHONEY. I assume the economic power of I. G. Farben-industrie was so great in Germany before the advent of Hitler that that organization, like the government itself, later, could use this process without much regard to world prices?

Mr. BROWN. That is correct, sir.

Of course, there is another point that comes in. Prior to the war gasoline was much more expensive in England than it was in the United States because of the fact that it had to be carried there either in the form of crude oil or gasoline. The Germans were not working against such a level of competition as would have existed in the United States.

They could not even have exported their products into England, although had they succeeded they would have realized much more for the product than they could anywhere in a country where there is a lot of oil.

Senator O'MAHONEY. England was dependent wholly on outside sources for petroleum?

Mr. BROWN. That is a fair statement. They made a little start on coal-tar hydrogenation and coal hydrogenation.

Senator O'MAHONEY. I was speaking of petroleum.

Mr. BROWN. Yes.

Senator O'MAHONEY. What was the situation with respect to this production in Germany?

Mr. BROWN. Germany had what we would regard as a small production of oil. Others are more competent than I am to give the number of barrels. As I recall, it was on the order of 10,000 to 15,000 barrels a day, in Germany itself.

Senator O'MAHONEY. Thank you, sir.

Congressman RANDOLPH. Then you think that the development of these processes to a greater degree on a commercial scale than we have in the United States and in other countries was due to the control of petroleum deposits?

Mr. BROWN. Yes.

Congressman RANDOLPH. Necessity made them go into these fields?

Mr. BROWN. Yes.

Congressman RANDOLPH. That is what is going to make us go into the field we are discussing here today.

Mr. BROWN. That is right, sir.

Now, as to the Bergius process for direct hydrogenation of coal: This process is carried out by mixing a small amount—usually less than 1 percent—of a catalytic material such as a compound of tin with approximately equal parts of finely powdered coal or lignite and heavy oil previously obtained from the process, and pumping this paste into a high-pressure chamber together with hydrogen gas at pressures of 3,000 to 8,000 pounds per square inch. The temperature of the reacting mass is maintained at 800° to 900° Fahrenheit.

The oil product from the reaction vessel is separated from the solid residue of ash-forming material and unliquefiable carbonaceous matter and is distilled into light-, middle-, and heavy-oil fractions. The light oil is further treated by passing it into a vapor-phase zone containing a fixed catalyst such as molybdenum or tungsten sulfide. The gasoline product has an octane rating of 70 to 75 which, by the addition of tetraethyl lead, can be increased to from 80 to 85 or higher.

Four or five tons of high-volatile bituminous coal are required for the production of 1 ton of gasoline—0.56 to 0.70 short tons of coal per barrel of gasoline.

This figure includes the coal needed for power, steam, and hydrogen used in the process; 6.5 tons of sub-bituminous coal, or 9 tons of lignite, are required for the production of 1 ton of gasoline—0.90 ton to sub-bituminous coal or 1.25 tons of lignite, respectively, per barrel of gasoline. These figures are based on recycling the oils heavier than gasoline to form lighter oils. It is possible to operate the process so that a portion of the yield consists of heavier oils similar to kerosene and fuel oil and the Bureau of Mines has developed a modification for the production of a heavy bunker C oil by hydrogenation at lower pressures of about 1,000 pounds per square inch.

High-pressure hydrogenation has developed into an extensive technology for the synthetic production of motor fuels and lubricating oils. In general, the reaction results in conversion of approximately

60 percent of the coal into oils and tars or products corresponding to "synthetic crude oils" capable of producing relatively high-octane gasoline. The hydrogenation process is also adaptable to the treatment of heavy asphaltic petroleum, shale oils, and tars.

Senator GURNEY. May I interrupt there? You say they are relatively high-octane gasolines. A paragraph or two back you said 80- to 85-octane gasoline. What did you mean there? Could you get above 85?

Mr. BROWN. Not without some further processing, Senator.

Senator GURNEY. Is 85 about the limit?

Mr. BROWN. Yes, sir.

Senator GURNEY. You will have to add some other material to get above that?

Mr. BROWN. You are thinking of high-octane aviation gasoline?

Senator GURNEY. I am thinking of the fact that 85 is the highest octane gasoline that you can get out of coal.

Mr. BROWN. That is the best we can do out of petroleum also, unless you go over to making some special chemical products such as alkylate to put into the gasoline or petroleum.

Senator GURNEY. Then this 85-octane gasoline that you get out of the hydrogenation of coal, with a high-pressure system, you can add these other elements to it, like we do with gasoline produced from crude oil, and make our aviation gasoline?

Mr. BROWN. That is correct.

Senator GURNEY. It gives us practically the same aviation gasoline then?

Mr. BROWN. Yes; as far as utility is concerned.

Senator GURNEY. And would be suitable for aviation purposes?

Mr. BROWN. Yes, sir.

Senator GURNEY. The high-compression motors I mean.

Mr. BROWN. That is right.

Congressman RANDOLPH. Continuing with your subject of aviation gasoline. Is it true, Mr. Brown, as reported, that the power of the German Luftwaffe is being weakened constantly not only due to the lessening number of planes and pilots, the over-all personnel, but due to the actual quality of the gasoline itself which is fueling Hitler's air machines?

Mr. BROWN. On the best information available to me, I would not think that to be the case. I think that the quality of gasoline available to the Germans, used in the type of aircraft engines which they design and build, is plenty good enough. There is a question about the quantity, but the quality, I think, is not any source of discomfort to them.

Senator GURNEY. Have you made any actual tests of the gasoline in grounded German planes?

Mr. BROWN. Yes, sir.

Senator GURNEY. How does it compare with our aviation fuel?

Mr. BROWN. You see the fuel and motor are a team, they must work together.

Senator GURNEY. I understand.

Mr. BROWN. You must compare the German fuel in the German motor, or the American fuel in the American motor. If you were to take the German fuel and put it in one of our motors, it would be

on the same general order of quality, a little bit on the low side, as the gasoline that we put in our motors, but they design their motors for that type of gasoline, and we design ours for our type, so it is very hard to make a comparison of the fuel alone without taking into account the engines, too.

On a broad statement, I do not believe that the Germans are suffering from deficiencies of fuel quality or deficiencies of power in the engines they use in their airplanes.

Senator GURNEY. Let us lay aside the matter of difference of engines for a moment.

What is the actual octane content of the German aviation gasoline?

Mr. BROWN. About 95 for the fighter type of fuel.

Senator GURNEY. Do they use alcohol to step up the octane content?

Mr. BROWN. As far as I know, they do not.

Senator GURNEY. Do they use alcohol at all in their aviation fuel?

Mr. BROWN. So far as I know, they do not.

There are times when they use alcohol in aviation engines, when it is very cold, or when they are supercharging, but in high octane fuel I do not believe they use alcohol.

Senator O'MAHONEY. Mr. Brown, you stated a moment ago, before we began to interrupt you with questions, that the hydrogenation process results in converting about 60 percent of the coal into gasoline. What happens to the other 40 percent?

Mr. BROWN. It is used in the job of doing it. Of course, some of it is ash, and nothing happens to the ash, but the rest of the coal goes into power, into making hydrogen or making steam.

Senator O'MAHONEY. So there are no byproducts that are worthy of mentioning?

Mr. BROWN. No, sir; except some gas or you can, if you wish, make heavy oil instead of gasoline. You can vary the type of product that you get out of it, but the yield would be the same anyway.

I was discussing the Bergius process. The plant at Billingham, England, has a rated capacity of 50,000 tons of gasoline from the treatment of coal tars and 100,000 tons of gasoline from the treatment of coal, making a total of 150,000 tons or over a million barrels production per annum. The yield of gasoline per ton, based on coal hydrogenated, is approximately 1 ton for each 1.5 to 2 tons of coal processed, or 1 ton of gasoline for each 5 tons of total coal employed, for all purposes including power, heat, and utilities generally, as well as for charging material. Gasoline of approximately 75-octane has been produced.

Fischer-Tropsch process: In the indirect hydrogenation process known as the Fischer-Tropsch process coal, lignite, or natural gas is reacted with steam to form water-gas, a mixture of carbon monoxide and hydrogen. The mixture of gases in proper proportion, after purification, is passed over a catalyst at relatively low pressures (1 to 10 atmospheres) and temperatures ranging from 360° to 530° F.

Iron or cobalt catalysts alone or mixed with various oxides, have been found to be satisfactory. By increasing the pressure and using a somewhat different catalyst, for example, iron containing various alkalis, a mixture consisting of alcohols, ketones, and aldehydes resulted, thus forming the basis for the production of various chemical derivatives and products.

Seventy-two percent of the theoretical yield or 1.4 gallons of synthetic oil per 1,000 cubic feet of synthetic gas has been obtained.

That is, by "synthetic gas" there, we mean the water gas we get from the coal. We get about 1.4 gallons per thousand cubic feet. When natural gas is employed about 3 to 5 gallons of crude-oil-like product per 1,000 cubic feet is produced. One ton of the primary products is obtained from about 4.5 tons of coke which, in turn, requires the carbonization of 5 to 6 tons of bituminous coal or about 0.70 ton of coal per barrel of motor fuel.

In other words, here again, as the previous witness indicated, you can use manufactured gas from coal, you can use natural gas, you can use coke; you can use anything that has carbon in it that will burn, and the yield depends on the quality of the raw material.

The octane rating of the gasoline is quite low (about 50-octane) and as is usual, increases with the lower-boiling fractions. Reforming and adding tetraethyl lead to the gasoline will bring it up to a fairly satisfactory motor gasoline.

The Diesel oil on the other hand, as would be expected, due to its high paraffinicity has a high-octane value, so that the process is eminently suited to produce this product. The paraffin wax and naphthenes have been found quite useful for the production of synthetic fatty acids by oxidation and subsequent conversion into soaps. The conversion of the olefin components of the lower-boiling fractions into lubricating oils by polymerization employing aluminum chloride has also been established.

In other words, in addition to being able to get gasoline, Diesel oil, wax, and things of that kind from the Fischer-Tropsch process, you can, by further manipulation, produce good quality lubricating oil.

The first Fischer-Tropsch industrial plant was put into operation in Germany in 1936 and by 1940 over 1,000,000 tons of liquid products were being produced annually in Germany by this process. Plants have also been built in other countries.

Senator O'MAHONEY. May I interrupt to ask you if you know by whom this plant was built in Germany in 1936?

Mr. BROWN. The Rhur-Chemie Co. was a sort of a second-string major chemical company in Germany. It was not then affiliated with the I. G. Farbenindustrie. Hitler forced the combination. The first development was by Ruhr-Cheme.

Senator O'MAHONEY. Did that have affiliation with any other companies?

Mr. BROWN. It was at first a large independent chemical company. I do not know about the ramifications, but they were not connected with the I. G. Farbenindustrie at the time.

Senator O'MAHONEY. Do you know what company built these other plants in other countries to which you referred?

Mr. BROWN. My information is that a plant was built in Japan.

Senator O'MAHONEY. By whom?

Mr. BROWN. I do not know the name of the company. Of course, it was obviously sponsored by the Japanese Government. I do not know whether it was Mitsubishi or Mitsui.

Licenses were granted to build those plants in a number of countries, but I do not know the companies which actually built them.

Senator O'MAHONEY. Do you know whether or not the Universal Oil Products Co. had anything to do with these plants?

MR. BROWN. I do not believe the Universal Oil Products Co. could have had anything to do with the Fischer-Tropsch process.

Senator O'MAHONEY. Why?

MR. BROWN. Because I do not believe they were working in that field at that time. I notice the next witness is a Universal man and he can probably answer the question better than I can.

Senator O'MAHONEY. Who controls that patent? I assume the Fischer-Tropsch process is patented.

MR. BROWN. It is so old, Senator, that some of the original patents have now expired, but the Ruhr-Chemie obtained a number of patents prior to its connection with the I. G. Farbenindustrie. The I. G. Farbenindustrie obtained a number of patents. I think most of the oil research groups in the United States have played with the process and have obtained patents on variants of it.

Senator O'MAHONEY. So it is more or less of a free process?

MR. BROWN. No, it is a "free for all fight."

At least, there is a considerable question as to who holds the dominant patent.

Congressman RANDOLPH. This plant built in Germany in 1936 by a private concern, was it not at the instance of the German Government and with funds of the Government that the plant was actually constructed?

MR. BROWN. That would be a matter of opinion as far as I am concerned. My opinion would be, nothing could be built in Germany in 1936 without Government permission. I do not know whether or not Government funds went into it.

Senator O'MAHONEY. Do you know whether there was any type of international cartel operating in this field?

MR. BROWN. There was an agreement first between the I. G. Farbenindustrie and the Ruhr-Chemie Co., and they consolidated the German patents.

There were certain cross-licensing agreements arranged between the German interests and some American interests, and I believe some British interests. Nothing particularly ever came from that, though, because no plants were ever built under those agreements. I believe the agreements have since been dissolved.

Senator O'MAHONEY. Have you ever heard of the International Hydrocarbon Synthesis Corporation?

MR. BROWN. Yes.

Senator O'MAHONEY. What is that?

MR. BROWN. I do not know whether it is still in existence, but it was a company that was organized to develop the Fischer-Tropsch process and certain allied processes in the United States. Among the companies interested in it were the Jersey group, the Shell group, and M. W. Kellogg Co., which is a prominent constructor of refining and chemical equipment.

Senator O'MAHONEY. You do not know whether it is still in existence or not?

MR. BROWN. I have been so busy I have not been able to follow these dissolutions and consent decrees to a sufficient extent to answer at all.

Senator O'MAHONEY. The reason I asked is to bring out whether or not there is any possibility of conflict between this Government and these international organizations that in the past have been so intent upon controlling processes of this character.

Mr. BROWN. I read Mr. Russell's testimony this morning here in the meeting and from that I would judge there was not.

I have some figures here on the estimated cost of production of synthetic liquid fuels from coal and natural gas.

The total cost of producing gasoline by direct coal hydrogenation under pre-war conditions has been estimated at from 10 to 25 cents per United States gallon depending on rates of amortization and plant capacity.

The Imperial Defense and Labor Committee reports of Great Britain in 1928 showed a cost of 18 cents per gallon. Mr. W. S. Farrish (Standard Oil of New Jersey) in 1942 testified before the subcommittee of the Mines and Mining Committee, House of Representatives, on gasoline from coal and estimated a total cost per gallon on a plant of approximately 3,000 barrels at about 23 cents by direct coal hydrogenation and 19 cents by the Fischer-Tropsch process.

Senator GURNEY. May I interrupt there, Mr. Brown? The end product under the Fischer-Tropsch process is not quite equal to the end product from the high pressure hydrogenation process?

Mr. BROWN. That is correct, sir, in that the octane of the gasoline is lower, but by reforming, which is a process we use in this country to raise the octane number of the low-octane gasoline, you can increase it somewhat.

Senator GURNEY. You would also increase the cost, would you not?

Mr. BROWN. Yes, sir.

Senator GURNEY. Thank you.

Mr. BROWN. I referred to that estimate of 23 cents by direct coal hydrogenation and 19 cents by the Fischer-Tropsch process. I understand testimony introduced before this committee has indicated the cost by the Fischer-Tropsch process would be considerably less than 19 cents. I hold that view myself.

In my opinion, the cost of gas made by the Fischer-Tropsch process would vary quite a lot, say from 5 to 10 cents a gallon, depending on the price at which you put in the natural gas from which you made it.

The cheapest way to make gasoline from the Fischer-Tropsch process, in my opinion, would be from natural gas, not from coal.

The cost of the plant itself has been variously estimated; a present-day approximate figure for a capacity of 3,000 barrels per day being of the order of \$50,000,000. For a 30,000-barrel-per-day plant the estimate was 16 cents per United States gallon.

With natural gas at 5 cents per 1,000 cubic feet it was estimated by Mr. Farrish that the cost of gasoline production by the Fischer-Tropsch process would be about 9 cents per gallon or lower.

I would concur in that, but as the price of natural gas goes down, the price of the product goes down too. Other estimates have been made as low as 5 cents per gallon so that with improvements resulting from research, development, and operating experience this process may be competitive with crude oil at \$2 per barrel or even less.

Senator O'MAHONEY. I suppose as the capacity of the plant is reduced, the expense of producing the gasoline would be increased?

Mr. BROWN. That is correct, sir, because the investment becomes a greater part of the cost. The raw material costs would be about the same in the big plant as in the little plant.

Senator O'MAHONEY. Have you given any thought to the investment that would be required to construct plants of the kind contemplated in this bill?

Mr. BROWN. I have, sir; and, in my opinion, a plant to produce about 3,000 barrels a day of liquid fuel from coal would cost \$50,000,000 or less, with the rock-bottom figure in my mind of about \$30,000,000.

Of course, if you built a bigger plant, it would not cost as much per barrel and if you built a lot of plants, you would learn so much in your first experience that I would expect the cost of subsequent plants to be lower. I would say somewhere between \$30,000,000 and \$50,000,000, depending on the design required.

Senator O'MAHONEY. Do we have any information on the cost of these German and British plants?

Mr. BROWN. I notice Mr. Russell of the Jersey organization had some tables attached to his testimony. I have no personal information with me this morning on it, but from my recollection it was of the order just stated.

Along that general line, though, just departing from my prepared statement, I made some computations that may be of interest. If you assume the low figure of \$30,000,000 for 3,000 barrels of gasoline, that is \$10,000 a barrel.

Prior to the war we produced and consumed in this country about 1,600,000 barrels of gasoline per day. Now, if that \$10,000 investment per barrel of gasoline holds, it would take about \$16,000,000,000 of investment to produce from coal as much gasoline as we currently use from oil.

Contrasting that, I imagine that the total refining investment at present is only about \$5,000,000,000. So we are looking at a tremendous cost in materials in dollars if we are considering a total substitution.

It is a big thing; it takes a long while.

Senator O'MAHONEY. It would not be altogether a fair comparison, would it, to compute the investment in hydrogenation processes at the rate required for a 3,000-barrel-a-day plant?

Mr. BROWN. It would not, sir. So it would be something less than that, but it is a tremendous amount of money. Of course, I shaved the estimate from 50,000,000 to 30,000,000 before I started out here.

Senator O'MAHONEY. I see.

Congressman RANDOLPH. May I follow it up for a moment?

Mr. BROWN, you, of course, are a gasoline authority, and I would like to put a question to you which, perhaps, may have merit and perhaps may get the answer I should like to get.

We will say that in this restricted eastern area from the standpoint of gasoline use during the past year, we would have had in operation in the vicinity of Washington, we will say, in Maryland, the eastern part of West Virginia and some of these other States, the Fischer-Tropsch plant.

Could that have been operated on the basis, throwing out the O. P. A. ceilings, of, say, an amortization of 6 percent?

Mr. BROWN. Operating from coal?

Congressman RANDOLPH. Yes.

Mr. BROWN. Just a minute. If there is no limit on the price, if you really eliminate the ceiling and assume no competition?

Congressman RANDOLPH. Well, it is a hypothetical question. I think we have to throw out certain ceilings, of course. But, say, in this area here surrounding Washington, if such a plant would have been in operation during the past, what would be your guess on the cost of amortization?

Mr. BROWN. If you assume that you get 16 or 20 cents a gallon for the gasoline?

Congressman RANDOLPH. Yes; the customer paying that amount.

Mr. BROWN. You would have to make another assumption as to the other costs, and you would leave something out of the 16 cents for amortization, you might leave 4 or 5 cents. Is that the type of thing you are asking me?

Congressman RANDOLPH. Yes; that is right.

Mr. BROWN. If you had made 3,000 barrels of gasoline a day, 42 gallons to the barrel would make it 126,000 gallons. Assume that you get 20 cents for it, just to make it easier for the computation, you would have, if I figure it right, a total realization of about \$25,000 a day from this plant which would have cost \$30,000,000.

If we assume our realization \$30,000 a day to make it still simpler, that would make it, according to my computation, on that basis you would have to devote the entire price of the product for 1,000 days; that is, the whole 20 cents a gallon would have to go for 3 years; you would not get anything.

I guess you could not allow any more than one-fifth, so I guess it would be paid off in around 15 years.

Congressman RANDOLPH. Would you advocate such a program in this territory?

Mr. BROWN. Last year? Of course, if we would not have had those ceilings we would have had more oil here anyway. I do not think I would, if you assume no ceilings, because it would not have happened.

Senator O'MAHONEY. Mr. Brown, the chart which Mr. Russell presented yesterday estimated the investment for the Fischer-Tropsch process, according to the present European design, using coal sufficient to produce 300,000 barrels a day at \$2,280,000,000. To produce 600,000 barrels a day it would seem to me that would amount to a total investment of \$4,560,000,000.

I understood you to say a little while ago that probably it would cost about \$16,000,000,000.

Mr. BROWN. Was he talking about gas or coal there, Senator?

Senator O'MAHONEY. I will hand you the chart. It is the third column.

Mr. BROWN. He used a figure of \$7,000 investment per daily barrel instead of \$10,000. I do not know. I cannot explain the other discrepancy, but he has a \$2,280,000,000 investment for 300,000 barrels, so I would just divide the 300,000 barrels there.

Senator O'MAHONEY. Here, again, there is a divergence in the opinions of experts. Thank you very much.

Mr. BROWN. I was asked to comment on the development work in connection with these processes. In view of the variables involved in the development of processes of the character described, it is obvious that there are many possibilities for improvement and future developments.

The present economic and technical status of these processes are such that both of them can be developed to commercial status without a large amount of development work. However, the experience gained during the past several years has shown that there is much room for improvement not only in respect of selection of materials such as types of coal to be treated, but particularly in connection with the development and selection of suitable catalysts and the determination of plant design factors and data to obtain maximum yield and efficiency. Also as would be expected in processes of this character, many improvements can be made in the purely mechanical aspects. For example, in the early days of the direct process a great deal of difficulty was encountered in feeding materials of a solid or semisolid character to the process under the high pressures required for the same. At present one of the principal problems in this process is the separation of unconverted coal from the recycle oil.

Coal hydrogenation: The Bureau of Mines has erected and operated an experimental coal hydrogenation plant with a capacity of 100 pounds of coal for each 24 hours producing 8 gallons of gasoline. The objective in this case was to study the hydrogenation of coal from various deposits or seams in the United States to determine the maximum quantity of oil which can be produced therefrom. Work of this kind should be continued to permit a selection of the proper types of coal for treatment. The lowest rank coal, namely, lignite and sub-bituminous coal, comprise 50 percent of our national coal reserves and many of these deposits can be mined merely by stripping methods and are easier to convert; however, they yield less oil per ton of coal than those of bituminous rank by various methods of treatment.

The work done at the Bureau of Mines is obviously a good start, but much more should be done, particularly in obtaining data for the design of commercial plants. The scale of operations is satisfactory to give information regarding selection of coal, but an intensive study should be made on a plant scale. A commercial plant having a capacity of the order of 1,000 to several thousand barrels per day should be engineered and built now; even though the process is susceptible to many improvements.

Among the important questions which must be considered in connection with the type of coal hydrogenation unit to be installed are:

(a) That it shall be of such capacity as to include all of the requirements and conditions for full commercial operation so as to present all the problems in connection therewith and so that a final design may be arrived at which will eliminate all of the problems connected with the operation of the process from the industrial and commercial viewpoints.

(b) That the plant shall be so located with respect to availability of types of coal to be treated that really suitable raw material (coal) may be used—thus eliminating unnecessary complication of operating problems.

For example, it appears to be more desirable to install a plant at a location where a type of coal is available which does not involve certain major operating problems such as the formation of insoluble materials which are not readily convertible. This is particularly desirable if such deposits are typical and contain sufficient coal to last on the order of several hundred years. The more difficult types of coal can be handled in plants which can be built later after more

experience and information on the subject is available, or modifications may be made in existing plants if necessary.

It has been found that sub-bituminous coal is the most desirable. This type of coal is particularly desirable in eliminating formation of heavy asphaltic material which cannot be readily hydrogenated or separated and which interferes with obtaining a steady state in the process. Another factor in the selection of coal, as already indicated, is the amount of insoluble material formed during the operation. In this connection it has been determined that sub-bituminous coals form only about one-quarter of the insoluble material as that formed by bituminous types which decreases very greatly the difficulties in treatment and continuous operation. Large deposits of such subbituminous coals occur in Wyoming, Colorado, and Montana.

The demonstration plant should have a capacity or through-put to conform to a typical commercial plant or generally speaking one which includes all of the operating characteristics of the minimum size commercial plant. In view of the operating experience at Billingham, England, it would appear that this could be taken as a standard. This plant consists of 2 units each comprising 2 sets of liquid-phase converters and two sets of vapor-phase converters. The entire plant has a capacity of 500 tons of gasoline per day or 1,000 tons of coal charged to the system based on a 50-percent yield of gasoline. Each set of 2 units each will yield approximately 250 tons of gasoline per day and it would appear that this could be taken as the standard size. It is also recommended that a complete plant be installed, including liquid- and vapor-phase converters, separators, and return systems in order to obtain complete operating experience and to facilitate thorough development.

We have been furnished considerable information through various channels from the Billingham plant in England.

Considerable information has been made available also to the Petroleum Administration for War and the Bureau of Mines about certain phases of coal hydrogenation by the Standard Oil Development Co. on the work done by the Imperial Chemical Industries during the period from 1929 to 1939, particularly on the hydrogenation of the products obtained from the hydrogenation of coal and oil.

Fischer-Tropsch process: The Fischer-Tropsch process has been fairly well investigated and engineering and economic studies made for possible commercial installation in the United States, particularly in respect of the production of gasoline from natural gas. This appears to be the logical raw material for quick development for the production of synthetic fuels, on a basis which approaches commercial operation although it may be taken for granted because of the limitation of this raw material that ultimate development should be in the direction of employing coal to make water gas for this process or of direct coal hydrogenation. In any event any plant built can be adapted when necessary to the treatment of coal as a raw material.

It is estimated that the cost of a plant to produce 150 barrels of crude Fischer-Tropsch product per day is of the order of \$1,000,000 and a plant one-third this size, which might be employed for operating and design experience would cost about one-half this amount.

The process can be installed in relatively small units and improvements in catalysts can be adapted to existing units, as it is quite certain

that such improvements will be made. It is, therefore, recommended that with these studies as a background and the cooperation of development and engineering companies or industry generally one or more intermediate or commercial size plants should be built immediately to develop this process.

Senator O'MAHONEY. Do I understand you to mean by that that, in your opinion, there ought to be a demonstration plant for natural gas at all events?

Mr. BROWN. Someone ought to build a plant, sir, for the same reason. It is nearer to us and will not last as long, but it is more nearly economical now and it can be done, and it is a part of the program which, in my opinion, should not be neglected from the national standpoint.

Senator GURNEY. If the cost of that plant was \$1,000,000 for 150 barrels a day, for half a million dollars you would have a much smaller amount than half of 150 barrels?

Mr. BROWN. Yes.

Senator GURNEY. While we are on natural gas, can you estimate how long natural gas would furnish us with all of the gasoline we can use—how many years it would furnish us with gasoline?

Mr. BROWN. We have estimated if we use natural gas for present purposes, at the present rate of consumption the existing reserves will last only about 30 years. If you convert it to the load of making all our gasoline it will last a very short time, from 3 to 5 years, perhaps.

Senator O'MAHONEY. If these processes were immediately developed, before the exhaustion of the petroleum reserves, the two could supplement one another?

Mr. BROWN. That is correct.

Senator O'MAHONEY. So that the period of use of both would be greatly prolonged; is that not correct?

Mr. BROWN. I think so, sir. I notice some of the discussion in yesterday's testimony—perhaps it was only in the newspapers—as to the order of precedence of these things, in what particular year we would run out of this and have to start to use that.

My personal view about that is if we assume private enterprise and personal initiative, several of these things are going to happen at the same time: Somebody is going to make liquid fuel from coal before they run out of oil, somebody is going to make liquid fuel from natural gas, people will make it from oil sands; they all run along together.

Senator O'MAHONEY. I think that comment arose from the testimony of Mr. Russell on the last chart which he presented which, as he himself testified, was based upon assumptions in which he himself did not believe. So it scarcely offers a basis for our conclusion.

Senator GURNEY. I think we hit on that chart that he gave us in order to get a definite idea as to the number of years' supply of motor fuel we could expect to get from each kind of basic material, then we tried to find out which was relatively the best. Well, as I see it, there is not much chance to use the next best basic material—natural gas—because we need it for other things.

You seemed to skip over, though, one material that Mr. Russell talked about, and that is oil shale, that he said was the next best material, and you jumped from natural gas to coal. What have you to say about oil shale?

Mr. BROWN. I was trying to shorten my statement. I cover that in the last page of my statement. What I have to say about it is, that people have been making oil from oil shale for many years.

Senator O'MAHONEY. I think we better get that last page in, because it concludes with a very interesting recommendation.

Mr. BROWN. This is in reference to other sources of liquid fuels. While shale oil has not been given extensive consideration in the above discussion, it is an important item in our future liquid fuel economy. The largest reserve of oil shales is in the deposits of Colorado, Utah, and Wyoming, and as pointed out previously, a total of approximately 92,000,000,000 barrels of oil are recoverable from these deposits, averaging about one-half barrel of oil per ton of shale. The technique of shale-oil recovery and refining is fairly well known since refineries for this purpose have been established long ago in Scotland, Australia, and France, and many investigations have been made in employing the crude oil as a feed stock for the cracking process to produce motor oil. However, much work requires to be done to produce modern motor and aviation fuels from shale oil, as well as recovery of the latter from oil shales. Also, it is reasonably certain that the techniques and equipment involved in coal hydrogenation will find application to shale. Other incidental hydrocarbon resources are the oil sands of Utah and other locations which have not been thoroughly explored but probably could produce several years of fuel supply by the application of proper technology. In this connection the Canadian deposits of this same type of fuel resources has been variously estimated from 125 to 250 billion barrels.

Expressing it in another way, the oil sands we have here, that are referred to, is a 3-year supply as contrasted to about 200 years in Canada. Canada has most of the oil sands that we know about now.

In conclusion, it is recommended that S. 1243 be approved so that we may obtain the know-how of producing synthetic liquid fuels, and to insure an adequate supply of the same for the future needs of the United States.

Senator O'MAHONEY. Are there any other questions, Senator Murdock?

Senator MURDOCK. I have none.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No more questions.

Mr. STRAUS. I have a question. Assuming that we have this plant under the Senator's bill, or otherwise, how far, in your opinion, could we go in exhausting our remaining petroleum and natural gas reserves?

Mr. BROWN. The Senator's bill provides for one 3,000-barrel plant. That will merely give us encouragement, the know-how and courage to go ahead. That is such a small plant compared to the demand in the United States for petroleum that if we had it here running right now we could not then decide what we would do about oil. We would have to build many more plants before it would have much effect.

Mr. STRAUS. In your opinion, if our economy was not disturbed by the war, would the processes advocated in this bill be carried out by industry?

Mr. BROWN. In my opinion, the Fischer-Tropsch process, using natural gas but adaptable to other materials, would be taken up by

industry. In fact, I think it will be anyway. They were very close to it prior to the war. It would be a nice thing if we had more oil now from natural gas, or from any other source and I think it would be followed up by industry. The coal hydrogenation process, while from the standpoint of ultimate supply of raw material is much more advantageous is, nevertheless, less economic, as shown by all the figures. It is further away. I think governmental support of that is more important, because if the Government does not do it, perhaps no one will.

Senator O'MAHONEY. Are there any other questions?

Senator MURDOCK. Mr. Chairman, may I have the witness repeat his answer, if I understood him correctly on this, that if we were limited now to the production of gasoline exclusively from natural gas, at the present rate of consumption that would only last, as I understood him, from 3 to 5 years. Is that correct, Mr. Brown?

Mr. BROWN. That is correct, sir. Of course, that is another one of these numbers, because we could not possibly build enough plants all at once to use up all the gas in 3 to 5 years. That is the figure, however, that I gave you, sir. I related the figure to other figures.

Senator MURDOCK. Still you think it is of more importance right now, due to a lesser cost, to go into that field rather than to go into the hydrogenation of coal?

Mr. BROWN. The point I have in mind is this, that there are places in the United States right now where there is a lot of gas and no use for it; and given the construction materials, whether it be Government-financed or privately financed, it would be physically possible to go to one of those spots and in a reasonable period of months build a plant which would immediately augment our petroleum reserves by that amount of production.

Senator MURDOCK. I have one further question. Whatever we do, as I understood you, in the treatment of natural gas would be readily adaptable, would it not, to the treatment of coal?

Mr. BROWN. It would, sir, because in both cases before you get anywhere with your plant to make liquid fuel, you first have to make water gas, a mixture of carbon monoxide and hydrogen. It really gets down, to use a rough analogy, to what you burn, whether you burn coal to make the water gas or whether you burn gas.

Senator MURDOCK. Is that also true of shale?

Mr. BROWN. I do not think you could burn oil shale as such, but you could get the oil out of the shale by distillation and other means. That would be a complete substitute for anything that we talk about here, because you would have your oil and all you would do is refine it.

Senator O'MAHONEY. You are familiar, Mr. Brown, are you not, more or less at least, with the operation of Standard Oil of Indiana?

Mr. BROWN. Quite.

Senator O'MAHONEY. There is a good deal of natural gas and oil shale in the area in which the Indiana company operates to a large extent, is that right?

Mr. BROWN. Yes, sir.

Senator O'MAHONEY. What prospect do you think there would be of a private company like the Standard of Indiana undertaking, it-

self, the construction of plants necessary to produce gasoline from natural gas first and then from oil shale?

Mr. BROWN. I think that there is a reasonable prospect that it would be a successful venture.

Senator O'MAHONEY. What are the obstacles to that being done now?

Mr. BROWN. Candidly, the principal obstacle to anything being done now is the shortage of construction materials.

Senator O'MAHONEY. I do not mean, of course, to raise that question of war priorities. I am thinking now in terms of normal trade practices.

Mr. BROWN. I should say the principal obstacle to any company—and I am including the Standard of Indiana, but the same thing would be true of others—

Senator O'MAHONEY. Surely.

Mr. BROWN (continuing). Is that in order to justify an investment of, say \$5,000,000, \$10,000,000, or \$15,000,000 in a plant that utilizes natural gas as the raw material, you must either own a tremendous deposit of natural gas all by yourself, or you must have worked out trades and deals with proprietors of gas fields so you can assure yourself of a supply of natural gas at a price for a sufficient number of years to amortize your investment. It is not the price of the gas, and it is not the fact of whether it is there or not; it is the difficulty of getting it in one place at one price.

Senator O'MAHONEY. And for a sufficient period of time?

Mr. BROWN. Yes.

Senator O'MAHONEY. To justify the investment in the operation?

Mr. BROWN. That is right.

Senator O'MAHONEY. Are there any other questions?

Senator MURDOCK. Let me ask this question. I am prompted to ask it by reason of some experiences I have had with war production.

Would it make any difference at all to, let us say, the Standard Oil Co. of Indiana in anything that they might undertake in the future if this experimental work or demonstration work was carried on by the Bureau of Mines initially or at this time? In other words, would your company, would the Standard Oil Co. of Indiana be perfectly willing to rely on the work as carried out by the Bureau of Mines?

Mr. BROWN. Senator, I am going to have to ask you to drop my company, because I have been away from it since November 1941. I would like to answer a hypothetical question rather than an actual one, because I certainly am not speaking for the company from which I came. Let us take the Standard of Jersey, to make it easier, and give an answer as to that. I do believe the Standard of Jersey would be perfectly willing to rely on the experimental work and figures and data provided by the Bureau of Mines.

Senator MURDOCK. Say that the Bureau of Mines goes ahead at this time and does the demonstration; then, in your opinion, that work will not have to be repeated or done over at a future date by private industry?

Mr. BROWN. Not unless further development after the Bureau's work makes it necessary. It occurs sometimes, many years afterward, that new technology comes in, and I think the Bureau itself would agree that the Bureau take another look at it. If the com-

mercial development follows close after the Bureau's successful operation of this plant, I would expect the engineering data would be directly useful.

Senator O'MAHONEY. Have you any opinion as to the amount of natural gas that is now being wasted?

Mr. BROWN. No, sir; I haven't. That is a little bit out of my field. My impression would be, as far as natural gas going right in the air is concerned, that that has been very greatly reduced. Of course, there are still relatively wasteful uses of natural gas, such as making carbon black or putting it back into the structure where you hope to get it out again.

Congressman RANDOLPH. Those carbon-black plants have practically all been closed, haven't they?

Mr. BROWN. No. There are more modern techniques used, which reduces the loss, but you are still burning a tremendous amount of gas to make a little soot.

Congressman RANDOLPH. Most of those plants in our State went out of business.

Mr. BROWN. Because of technological advances in other places they get a bigger yield and it costs less, and so forth.

Senator O'MAHONEY. Thank you very much, Mr. Brown. We are indebted to you for your testimony.

Dr. Egloff.

STATEMENT OF GUSTAV EGLOFF, DIRECTOR OF RESEARCH, UNIVERSAL OIL PRODUCTS CO., AND PRESIDENT, AMERICAN INSTITUTE OF CHEMISTS, CHICAGO, ILL.

Senator O'MAHONEY. Will you give your name to the reporter, please, and your association?

Dr. EGLOFF. Gustav Egloff, director of research, Universal Oil Products Co., for the past 27 years, and president of the American Institute of Chemists.

Senator O'MAHONEY. What is the Universal Oil Products Co.?

Dr. EGLOFF. It is a research and development company in the field of hydrocarbons from every source, naturally and produced in the past. These processes include the development of motor fuel by thermo-cracking aviation gasoline, 100-octane, catalytic cracking, alkylation, isomerization of toluene for TNT, butadiene and ethylbenzene for synthetic rubber.

The processes are licensed to any company which desires to use them.

Senator O'MAHONEY. The company is a joint enterprise of several of the large oil companies, is it not?

Dr. EGLOFF. The ownership rests in the Standard Oil of California and the Shell Co., as far as I know.

Senator O'MAHONEY. The Atlantic Refining Co. has also some stock in it?

Dr. EGLOFF. They have some kind of interest, but what kind I do not know. The Texas Co., the Standard of Indiana, and others have also some interest.

Senator O'MAHONEY. In any event, it is a research organization which has been delving into this and related problems for a long period of years?

Dr. EGLOFF. Yes, sir.

Senator O'MAHONEY. Has it built plants throughout the world for hydrogenation of gas and coal?

Dr. EGLOFF. We have built plants primarily in practically all refining centers of the world to process petroleum, produce greater yields and better quality of product. We have built plants in Manchuria, Australia, France, to process shale oils into motor fuel of a high octane rating value.

Senator O'MAHONEY. A plant was built in Japan in 1937 also, was it not?

Dr. EGLOFF. Yes. We built a refinery in Sweden at Nvashem to process petroleum oil. When the war came on, their supplies were cut off and the Government became very active in producing shale oil from several processes, and this refinery cracked these oils into motor fuel.

Senator O'MAHONEY. Do you know what the source of raw material for the Manchurian plant was?

Dr. EGLOFF. Yes. Manchurian oil shale that is retorted. The initial plant we built was something like 800, I think, barrels a day input, but we had indirect sources that they doubled the capacity of the shale-oil plants and cracking plants.

Senator O'MAHONEY. What was the source of raw material for the plant in Japan?

Dr. EGLOFF. Shale oil in Manchuria. You say in Japan?

Senator O'MAHONEY. In Japan.

Dr. EGLOFF. Petroleum.

Senator O'MAHONEY. From what source?

Dr. EGLOFF. Derived from their own small production in Japan, in the half of Sakhalin Island, and the balance they bought from the Russians. The island is owned by the two countries.

Senator O'MAHONEY. What was the capacity of that Japanese plant, if you recall?

Dr. EGLOFF. About 2,000 barrels of cracking a day.

Senator O'MAHONEY. Do you know anything about the investment cost for the construction of the plant?

Dr. EGLOFF. Of the plant itself?

Senator O'MAHONEY. Yes.

Dr. EGLOFF. The cracking plant?

Senator O'MAHONEY. Yes.

Dr. EGLOFF. Two thousand barrels; that would be about \$400,000 erected there, say, \$200 a barrel input.

I might say, Senator, that the Belgian plant, the original one we built, the Belgian cracking company was to convert low-temperature coal tar into motor fuel. It ran for a short time on that and then it went over to petroleum oil shipped in.

Senator O'MAHONEY. Do you intend to discuss the probable investment requirements for plants in the United States in your paper?

Dr. EGLOFF. I have no formal written statement. I have a series of notes, and if it is agreeable I will run through them, and will be glad to answer questions, naturally.

In the coal hydrogenation, the direct method, the Bergius process, I have seen that in operation in Germany in a number of plants at Holten, Gelsenkirchen, and other places. A plant was also built in

England. You must recognize that the building of the plant, taking it from the day they started to design it for a commercial need, is about 10 years old, and a tremendous amount of technical knowledge has been derived, certainly in Germany, with the number of units they have put in, the size, and in many cases, according to technical reports, at much higher pressures than prevailed in the last units that were operating.

They built a plant that produced something like 3,000 barrels of about 72-octane gasoline, and by a special catalyst they could raise that to 75. I made a number of calculations based upon the Falmouth report.

I want to state, first, that I am in wholehearted agreement with making a study of every potential source of oil from raw materials in the U. S. A. on a size scale necessary to give us the engineering data that is necessary. I would not rely solely on the design unit that is operating in Billingham, which I saw last in 1937.

Now, this unit, according to the data given by the Imperial Chemical Co., producing 3,000 barrels or so a day, requires 6,000 men to produce the coal, de-ash it, wash it, grind it, and finally, through the processing unit—and I figure that on the theory that we are at the moment out of oil in the U. S. A.—to produce the present quantity of crude oil of, say, 1,400,000 barrels, in round numbers, daily, that we are producing in the States, it would require something like 8,000 men, on the basis of the data submitted by the Imperial Chemical Co. There is no doubt in my mind that we could cut that down very substantially, perhaps in half, or at least three-quarters.

Senator GURNEY. Did I understand you right when you said 8,000 men could produce our total requirements of gasoline from coal?

Dr. EGLOFF. Eight million.

Senator GURNEY. You said "thousand."

Dr. EGLOFF. I mean 8 million. I thank you for the correction.

I made a calculation, based upon the data obtained in connection with the cost of the plant, as of the period in which it was built, and the unit cost is something like \$40,000,000, in round numbers, and to produce the quantity of oil that we require would take an expenditure of \$22,000,000,000. I think the data presented yesterday by Mr. Russell is, with our technical knowledge, it would bring that down to the order of half of that.

Senator O'MAHONEY. Would you be good enough to identify the Falmouth report for the record?

Dr. EGLOFF. Yes, sir. Do you want me to do that now?

Senator O'MAHONEY. Yes. Just read the title.

Dr. EGLOFF. The Committee of Imperial Defence, Subcommittee on Oil from Coal, Report, February 1938, London.

Senator O'MAHONEY. Where is it obtainable?

Dr. EGLOFF. I have it here.

Senator O'MAHONEY. Where is it obtainable?

Dr. EGLOFF. There are very few in the country. You undoubtedly have it in the Congressional Library. If not, you may use this copy here.

Senator O'MAHONEY. I am just trying to get this in the record so any person reading the record may know what it is. It is published by the British Government, is it not?

Dr. EGLOFF. That is right.

There is another process in Germany called the Pott-Broche process that operates at 10,000 or 12,000 or higher pounds' pressure where they use tetralin as the hydrogenating agent to produce oil and gasoline from heavy oils.

I think there is another line of approach to this problem, Senator. The Bergius and Pott-Broche processes are in commercial operation now, but it seems to me that Bureau of Mines power lines could well undertake a study of generating the hydrogen within the retort system itself by adding material such as water and some metal that reacts with the water forming an oxide and hydrogen. Some experimental work has been carried out along that line in Germany.

Another line of attack is the oxidation of coal merely to put it in better form for the purpose of converting its oils.

It is of importance to bring out the fact that the Albanian heavy oils, operating under the high-pressure hydrogenation, would correspond somewhat to the tar sands that Mr. Russell spoke of yesterday. The last report I saw, they are treating at the rate of something like 2,000,000 barrels or so a year at two points in Italy.

Now we come to the Fischer-Tropsch process. It might interest you to know that we brought Dr. Tropsch over to the United States in 1930. Unfortunately, he died in 1937 or 1938. We obtained some knowledge of his process.

I had the privilege of seeing this Ruhr-Chemie plant at Holten in the Ruhr in operation under the directorship of ex-Professor Martin, and for the amount of work that is accomplished in that plant, from the standpoint of production, it is a very slow catalytic reaction of carbon monoxide and hydrogen or water gas under 200 pounds' pressure at about 400° Fahrenheit, and it produces, as has been stated by Mr. Brown this morning and others, a low-grade gasoline. We have made many cracking tests on this gasoline, also the wax and Diesel component, and under cracking conditions with an addition of tetraethyl lead you get about 72-octane rating, with very heavy losses involved.

However, this Fischer-Tropsch material has, I believe, great value from a Diesel-oil standpoint. It has more than a 100-cetane number. It makes an excellent blending stock with lower-grade Diesel oils. It also is a potential source of very high-grade lubricating oil. By cracking paraffin in Holten, at the Ruhr-Chemie plant, they convert the balance of the oil under cracking conditions into a stock which would contain high percentages of monoolefins, which are mixed with aluminum chloride, and it polymerizes the olefin into a high-grade lubricant, which might be one of the main sources of Germany's lubricating oils for airplane use.

Senator O'MAHONEY. What is the principal product of the Ruhr plant?

Dr. EGLOFF. They have a very large synthetic ammonia plant and nitric acid plant.

Senator O'MAHONEY. I mean with respect to lubricants and gasoline.

Dr. EGLOFF. Paraffin wax in part. A melting point wax can be produced, a product that we cannot obtain from petroleum. It has a lot of specialty uses in addition to motor fuel.

I failed to mention earlier that in this coal hydrogenation you get about 10 percent of gas along with your gasoline, made up of methane, ethane, propane, and butane.

Senator O'MAHONEY. When was this plant built in the Ruhr?

Dr. EGLOFF. I think around 1936. I saw it is in 1937.

Senator O'MAHONEY. What was its total over-all capacity?

Dr. EGLOFF. As I recall, about 1,000 barrels or so—800 to 1,000 barrels of liquid product, with the dissolved wax in the liquid.

Senator O'MAHONEY. What was the investment?

Dr. EGLOFF. It is about the same order of cost as the coal hydrogenation for an equivalent output.

Senator O'MAHONEY. It was a successful project, was it not?

Dr. EGLOFF. From a technical standpoint, no question about that, and a use standpoint; yes. The economics is something else. We could have shipped in gasoline at a far lower price in those years than we could get it into Germany, but it was ersatz material for the war to come.

Senator O'MAHONEY. What prospect is there for a plant of the same character to be built in the United States with greater economic justification?

Dr. EGLOFF. In the United States, based upon methane as a raw material to be converted by steam into the water gas and then catalyzed into these liquid products, we have a far cheaper raw material than coal, which goes into a retort to be coked, and the coke is then converted into water gas.

Senator O'MAHONEY. So that your conclusion is that there are better opportunities for commercial production in the United States than in the Ruhr?

Dr. EGLOFF. I would think so. I am fortified in that opinion by what Mr. Farrish testified to before Congressman Randolph's committee last year. He states here a number of possibilities for improvement in the Fischer-Tropsch process are known to exist. The Standard Oil Co. and other companies are working on it. In essence, if the war had not come on, they would have gone ahead with a commercial plant operating somewhere in Texas where natural gas is at a low price. There are many fields that I can see broadened by this Fischer-Tropsch process, especially the production in addition to motor fuel.

Senator MURDOCK. May I ask this question, Mr. Chairman?

Senator O'MAHONEY. Senator Murdock.

Senator MURDOCK. Did I understand you correctly in this, that our raw material here would be cheaper than it would be in the Ruhr?

Dr. EGLOFF. Yes, sir.

Senator MURDOCK. What raw material do you refer to here in the United States?

Dr. EGLOFF. Natural gas.

Senator MURDOCK. As compared to coal?

Dr. EGLOFF. To coal, coke, that they use in Germany. Some of our natural gas is relatively pure, very low in hydrogen sulfide. In the Fischer-Tropsch process you must have a highly purified water gas or you poison your catalyst.

Senator MURDOCK. Would the commercial possibilities, say, of the two plants be similar, supposing that the one here in this country would use coal?

Dr. EGLOFF. Coal would be far more expensive than natural gas as a raw material.

Senator MURDOCK. I am now comparing the coal of the Ruhr with the coal here. Would you say that the commercial possibilities of a plant here would be greater than they are in the Ruhr?

Dr. EGLOFF. The cost of producing coal I believe is much higher in the United States than it is in Germany. Labor income is rather low there. It was in 1938 when I was there.

Senator GURNEY. The basic material you would use would be the same here as they are using in Germany? The chemical make-up of our coal is about the same and you could expect about the same results; is that right?

Dr. EGLOFF. That is right.

I am inclined to believe, with the technologies of the U. S. A., they would do a far better job in the design of a commercial unit.

Congressman RANDOLPH. Dr. Egloff, you are just reading, of course, from notes. I do not want to break the continuity of your testimony. I want to ask you certain questions about the oil resources of the United States. Would you rather wait until later, at a point when you would develop that?

Dr. EGLOFF. That question is bad at any point. From the standpoint of listening to the testimony yesterday, I am not one of those gloomy prophets, and I believe if we search diligently enough, put enough manpower on the job, that we are going to find large quantities of crude oil in the United States. We haven't, in my opinion, really tapped our oil resources. Mark you, I want to see a program and development go on as rapidly as it is possible with the best brains that the country has, but we must not forget that there are vast quantities of oil where the fields are more or less depleted from the present methods of recovery.

Congressman RANDOLPH. Dr. Egloff, at the time of your testimony before the House subcommittee June 18 last year, you stated oil is being produced at the present time probably faster than we can consume it.

Dr. EGLOFF. Yes.

Congressman RANDOLPH. Is that still your opinion some 14 months later?

Dr. EGLOFF. Yes, sir.

Congressman RANDOLPH. I remember that your testimony on the subject of oil resources was most optimistic.

Dr. EGLOFF. Yes.

Congressman RANDOLPH. I read what you said then to compare it with what you said this morning, in view of the comment of Mr. Russell yesterday. You also said during that testimony that you felt that the coal industry had lagged far behind the oil utilities or other industries in research work, and therefore that is one supporting reason why you would endorse this legislation and further research looking toward the hydrogenation of coal. Is that correct?

Dr. EGLOFF. Yes.

Congressman RANDOLPH. Although you are essentially an oil man you feel we should not stop any program which is contemplated under

this type of legislation. The fact is you believe in the proposal of Senator O'Mahoney?

Dr. EGLOFF. Yes, sir; I urge that we do the maximum. I know the ingenuity of American scientists and technologists, and with that ingenuity we will find other products perhaps even more important, in part at least, to the motor-fuel side.

Coming back to the quantities of oil, the best geologists advise producers that from 70 to 80 percent of our oil is not recoverable by the present methods used in the United States.

Congressman RANDOLPH. Dr. Egloff, you heard the testimony of Secretary Ickes yesterday?

Dr. EGLOFF. Yes, sir.

Congressman RANDOLPH. Do you disagree vigorously with his opinion on the depletion of our oil reserves?

Dr. EGLOFF. I disagree with him.

Senator GURNEY. In other words, you feel our oil supply is more than 15 or 20 years?

Dr. EGLOFF. Oh, yes. From 1860, after the first well came in, from then for about every 5 years I have a chart on oil shortages. They said in 1861 that at the rate we were consuming our oil we would be out of it in a few years. I dare say we will be out of it some day, but I doubt whether any man in the room will live that long, and I doubt whether our children will live that long.

Senator O'MAHONEY. If it be true, as testified yesterday by Mr. Duce, that in the United States there has been drilled one well for every 3 square miles, what prospect do you think there is for additional discoveries?

Dr. EGLOFF. Well, that does not throw much light on it. It is a dramatic expression when we say "every 3 miles." There are enormous areas not drilled upon. Geologists say a good portion of our country is sedimentary, and where there are sedimentary deposits there is hope for oil.

At Wietzer near Hanover, they have been mining oil sands that they bring to the surface of the earth in a similar manner to coal. They wash the oil and refine it, and have a mountain of sand. We haven't touched that at all in this country. What the price will be I do not know.

Senator O'MAHONEY. What you mean then is that there are great possibilities of producing crude oil by secondary processes?

Dr. EGLOFF. Yes, sir; that is now in the ground.

Senator O'MAHONEY. That requires a further development of technology, does it not?

Dr. EGLOFF. Well, I think we could use the technique of the coal industry and the technique of Germany and in Alsace.

Senator O'MAHONEY. The question then would arise whether it would be more economical to pursue the hydrogenation process with respect to natural gas, shale, and coal, than to pursue the secondary methods of recovery of oil now left in the ground under the present system of production, would it not?

Dr. EGLOFF. Yes, sir.

Senator O'MAHONEY. Do you have an opinion on that?

Dr. EGLOFF. Well, I think this mining of oil sands might be considered by your committee, as you are, as I understand it, not solely interested in substituting fuels but also in recovery of oil.

Senator O'MAHONEY. That is right. Do you care to express any opinion as to the cost of that as compared with the processes which we have been discussing here?

Dr. EGLOFF. My guess is that in some spent oil fields here, where there is low production, with a barrel of crude oil per day, that we might do that.

Senator O'MAHONEY. On what do you base that conclusion?

Dr. EGLOFF. They are shallow fields. You do not have to go over 500 to 1,000 feet.

Senator O'MAHONEY. Mr. Brown, do you have an opinion on that?

Mr. BROWN. The relative cheapness of producing oil from your sands as compared to producing oil from hydrogenation?

Senator O'MAHONEY. That is right, by the secondary methods.

Mr. BROWN. Well, I venture this opinion, that the principal reason that the thing has not been done on a large scale up to now has been due to the unfortunate fact that the oil sands are available where there is not a whole lot of water. The best known method involves the use of a lot of water. If you can solve the water problem you are pretty well along on the sand problem.

On a very considerable scale of operation, and assuming water is somehow available, the cost of oil from extracting it from oil sands would be somewhat less than the cost of extracting it from coal.

Senator O'MAHONEY. That suggests a question which I will address to both of you. Would it be preferable to have the Government undertake to stimulate secondary recovery than to proceed along the lines of hydrogenation of coal, shale, and natural gas?

Mr. BROWN. Well, the figure that we have, that I gave your committee, Senator, would have indicated that the amount of oil to be obtained from oil sand would be just infinitesimal compared to the amount of oil that could be obtained from coal. I have a figure of around 3 to 5 years, based on our own domestic deposits.

Senator O'MAHONEY. Now, Dr. Egloff.

Dr. EGLOFF. Well, there is an experiment going on now in Franklin, Pa., where they have sunk a shaft and let the oil drain from the sands and then collected it. That is going on now. I have forgotten the diameter of the shaft, but it is a husky size. Then being an experimentalist and research man, you might start there with combustion in some of our oil wells and distill the oil out of some of our sands. I will touch on that when I come to the oil-shale section of my notes here.

Senator O'MAHONEY. You may proceed.

Dr. EGLOFF. In coming to the oil shale, there are now six countries or so that are producing commercially shale oil in substantial quantities. There is an industrial background, particularly in Scotland, of over 70-odd years or thereabouts. Having seen that plant and crawled all over it, it looks like a straight mining job and retorting. There are a half-dozen different methods, depending upon the country.

The one most widely used is the Pumpherston type, used in Scotland and also in Australia. There is a substantial oil-shale industry in Australia, cracking some of the oil into high-grade motor fuel. In Sweden there are four types. One of the latest is where they drill holes into the oil shale and insert electric heaters and distill the oil out of the shale in situ, without going to the mining step at all.

Now, John Fell of Australia, who put in our cracking plant years ago when he was in the United States, had a mountain of shale and he drilled a vertical shaft and a horizontal one and started a fire at the base and distilled out of the mountain of shale the oily material and collected it. He operated for some time that way until the Labor Party came into power in Australia, and they shut him down on the ground that he threw too many men out of work, so he had to mine the shale and bring it up in 2-inch lumps, drop it into the retort, and so on. I think that might be investigated also.

Shale, I think, should be thoroughly studied. We have, as you all know, I think, as high as 90 gallons in some cases per ton, and I think Mr. Winchester's estimate of, I think, something like ninety or ninety-five billion barrels, as I recall the figures, of actually obtainable oil might be restudied by the Bureau of Mines, and I would not be surprised if they would up that figure several fold. It was done away back 40 years ago, and we know more about it now.

It will cost probably much more money than Mr. Winchester was able to spend on it, but it is an order of figure of that period of years ago.

Now, coming to compressed hydrocarbon gases, in Europe there are 110,000 motor vehicles, busses and trucks that are operating on natural gas, methane and ethane, propane from the coal hydrogenation units, the Fischer-Tropsch process, and natural gas wells, and some trains are operating on compressed gases. Natural gas is largely methane. You can compress that under 4,000 or 5,000 pounds' pressure in the cylinder, liquefying it, and you operate your motorcar just the same as if you had gasoline in the tank. Germany and Italy have many filling stations exactly the same as our gasoline filling stations, only the gasoline is under these high pressures. The tanks are rather heavy, they weigh from 150 to 200 pounds, and some of the trucks have as many as six or eight of them under the running board.

I suggest as a problem to the Bureau of Mines to work out an alloy steel of relatively low weight and of 15- or 20-gallon size, and we have a potential source of motor fuel that is very high in anti-knock properties.

I made a calculation on the 3,100 billion cubic feet of natural gas that were used in the United States last year, if that were all liquefied it would have a gallonage of 40,000,000,000 gallons of potential motor fuel, which is 50 percent more in volume than the figures given us by Mr. Russell for 1941 of about 26,000,000,000 gallons of gasoline consumed yearly in the United States.

We would compress our refinery gases, methane and ethane, into a liquid and that would give us something like 6,000,000,000 additional gallons of compressed gas. The methane that is derivable from coke-oven gases would add another 1.5 billion gallons to the potential supply, and if we put in a battery of direct hydrogenation and the indirect hydrogenation, you could figure on a percent of the product produced from those processes.

Many European cities are utilizing the methane gas from the sewage of the cities and compressing it into a liquid for motor fuel. They are also using, in some motor vehicles, a mixture of carbon monoxide and hydrogen under high pressure as a motor fuel. I

bring that in to indicate that the water gas produced from coke or natural gas, if you wanted to use that kind of a mixture, can be a form of motor fuel.

They are also using acetylene in Europe with or without ammonia as a motor fuel, deriving their acetylene from coal. I do not know the manufacturing cost of making acetylene from coal, but I would not be surprised if it is the order of about 5 cents per pound of acetylene.

France is using quite a number of them with these same type of cylinders used for compressed methane and ethane. You might be interested, as a potential problem to work on, in the use of coal or coke or mixtures as a motor fuel source, by dropping these mixtures into a retort on the running board of a truck or bus and starting a fire at the bottom. You produce a gas that is cooled, de-dusted from the solid particles therein. There are many busses and trucks and motor-cars using anthracite coal, coke and other coal, wood charcoal, and a whole host of other materials like peat, corn cobs, flax waste, lignites, coffee husks, nut shells, cottonseed, and so on.

Senator O'MAHONEY. Your testimony would indicate when we run out of natural gas, then run out of shale, then run out of coal, we could still turn to these other substances and science will enable the human race to produce about all the fuel it needs.

Dr. EGLOFF. All these that I have mentioned are actually being used in some parts of the world. I would like to give you the number of gas motor vehicles operating in the world. I have been able to get about 812,000 of them.

Senator O'MAHONEY. I gather the conclusion from what you have testified to this morning that the possibilities of science are practically unlimited.

Dr. EGLOFF. Yes.

Senator O'MAHONEY. Necessity is still the mother of invention, and when they run out of one source of supply they can turn to something else.

Dr. EGLOFF. That is right.

Senator O'MAHONEY. But your conclusion is that at the present time it is advisable to proceed along the lines outlined in this bill?

Dr. EGLOFF. Yes, sir; I would like to bring a few other facts to you.

Continental Europe has 525,000 of these producers of gas. Brazil has 20,000 of motor vehicles, and all in 2 years. I was in Rio de Janeiro and Sao Paulo a little over 3 years ago and they had 6, but since that time there are 20,000 operating and they are building 1,000 a month. The number of cars operating substitutes for about 25,000,000 barrels of gasoline a year.

Congressman RANDOLPH. Mr. Egloff, are you familiar with the work being done by the Chicago Tribune in connection with the use of charcoal for making gasoline?

Dr. EGLOFF. Yes; they headlined the fact that in Canada they had experimented with it and had a wood-burning motor vehicle in connection with the wood-paper plant. I wrote to Colonel McCormick, giving him the data I just presented. There are only 812,000 of them in the world, and there are, I think, 6 or so in the United States.

Here is a picture of a truck and motorcar that just came in by mail. That is owned by the Champion Paper & Fibre Co. of Canton, N. C.

Senator O'MAHONEY. Doctor, it is almost 12:30. The committee will recess in a few minutes. Then this afternoon we will endeavor to conclude the hearing in Washington. There are five or six witnesses to be heard this afternoon.

I take this opportunity to recite the names of those persons whom the committee would like to hear from:

Mr. Martin J. Gavin, of the Foreign Division of Petroleum Administrator for War;

Dr. C. E. MacQuigg, the dean of engineering, Ohio State University, Columbus, Ohio;

Mr. C. S. Snodgrass, Foreign Division, P. A. W.;

Dr. Frank Mueller, president of the American Lurgi Corporation;

Mr. Walter H. Wheeler, consulting engineer with the Alien Property Custodian's Office; and, finally,

Dr. A. C. Fieldner, Chief, Fuels and Explosives Service Bureau of Mines.

When the committee recesses at 12:30 it will resume at 2:30, and I shall ask these various witnesses to endeavor to conclude their testimony this afternoon.

Dr. EGLOFF. Senator, I believe Senator Gurney asked a question of two witnesses as to the reserves of natural gas.

Senator GURNEY. That is correct.

Dr. EGLOFF. A year ago the National Gas Association gave two sets of figures. The known reserves were 85 trillion cubic feet, and that would figure a 28 years' supply at present consumption rates, and another 85 trillion potential, so we have an order of a figure as of a year ago of 56 years of natural-gas supply.

Senator GURNEY. Using the natural gas for its present uses?

Dr. EGLOFF. That is right.

Senator GURNEY. But my question was, if we convert that to gasoline, all of it, how many years would it last at our present rate of consumption of gasoline?

Dr. EGLOFF. That is, convert the natural gas into gasoline by the Fischer-Tropsch process?

Senator GURNEY. That is right.

Dr. EGLOFF. Taking the figure out of Mr. Brown's address, if we use the 3,100,000,000,000 cubic feet of natural gas of last year and 5 gallons for each thousand cubic feet, it would be 15,500,000,000 gallons of gasoline, on the basis of Mr. Brown's 5 gallons per thousand feet of natural gas.

Senator GURNEY. Thank you very much.

(Whereupon, at 12:30 p. m., the committee recessed to 2:30 p. m. of the same day.)

AFTERNOON SESSION

(Pursuant to adjournment for the noon recess, the hearing was resumed at 2:30 p. m.)

Senator O'MAHONEY. The first witness this afternoon is Mr. Martin J. Gavin, Foreign Division, Petroleum Administration for War.

Will you please come forward, Mr. Gavin?

**STATEMENT OF MARTIN J. GAVIN, CHIEF, REFINING SECTION,
FOREIGN DIVISION, PETROLEUM ADMINISTRATION FOR WAR**

Senator O'MAHONEY. Will you be good enough to give your name to the reporter, Mr. Gavin.

Mr. GAVIN. Martin J. Gavin, Chief of the Refining Section, Foreign Division, Petroleum Administration for War.

This is a statement on shale oil.

No. 1. Availability in the United States: In all probability the best present estimate of the quantity of oil recoverable from the oil shales of the United States is that given by Dean E. Winchester, published under the title, "The Oil Possibilities of the Oil Shales of the United States," in appendix I, report II, of the Federal Oil Conservation Board to the President of the United States in January 1928.

This estimate indicates that in the Tertiary oil shales of the Rocky Mountain States, the Devonian black shales of the Central States and the Cannel shales of the Central Eastern States there is represented a total of approximately 144,000,000,000 barrels of oil, of which Mr. Winchester estimates some 92,000,000,000 barrels is recoverable. The largest available reserve is that of the Tertiary deposits, Colorado, Utah, and Wyoming, from which Mr. Winchester estimates some 75,000,000,000 barrels may be recoverable.

Senator O'MAHONEY. May I ask you, Mr. Gavin, the same question I asked this morning of one of the witnesses, Do you know on what formula this estimate is based?

Mr. GAVIN. The estimate was made by Mr. Winchester at the time he was with the United States Geological Survey. As I recall—it is some time since I read his report in full—it was based, I think, on the most extensive sampling done by any individual or agency in the United States. He found a rather uniform correlation of shales, particularly in the three Western States, three Rocky Mountain States, remarkable correlation as to thickness of deposit, and quality of shales over a rather large area, and on that basis, although the number of individual tests are relatively few for such a large area, the estimate was based, and in my opinion—I talked several times with Mr. Winchester before his death—I believe the estimate is quite conservative.

Senator O'MAHONEY. Do you know whether or not the Bureau of Mines experiments on oil shale in the Rocky Mountain area in 1926 entered into his estimate at all?

Mr. GAVIN. It did not. The estimate was made before that time.

Senator O'MAHONEY. I notice that the report to which you refer here in your statement was made in 1928; that is to say, 2 years after that experiment.

Mr. GAVIN. If I am not mistaken, the report was made on the basis of his earlier and more complete examination.

Senator O'MAHONEY. But you feel that it is a conservative estimate?

Mr. GAVIN. I feel that it is a conservative estimate; yes, sir.

Senator O'MAHONEY. And on what do you base that, Mr. Gavin?

Mr. GAVIN. I base it on, perhaps, a much more limited area than Mr. Winchester covered. I base it on tests made by the Bureau of Mines at that time under my direct supervision in a rather limited area in Colorado and Utah.

We found that same correlation and, if anything, somewhat greater thicknesses of what we would call representative oil shales than Mr. Winchester reported in his earlier work.

Our work did not cover areas in Wyoming, but based particularly on Mr. Winchester's work, I should believe the correlation would be as uniform as he indicated.

Senator O'MAHONEY. Thank you.

Senator MURDOCK. May I ask you: I understand you to say that some of the work done in connection with the shale was done under your supervision?

Mr. GAVIN. Yes, sir.

Senator MURDOCK. Were you with the Bureau of Mines at that time?

Mr. GAVIN. I was with the Bureau of Mines from 1918 until 1929.

Senator MURDOCK. Do you know L. C. Karrick?

Mr. GAVIN. Yes, sir.

Senator MURDOCK. Are you familiar with the work he did?

Mr. GAVIN. I am familiar with the work he did under my supervision up until he left the oil-shale section, I think we might call it, in 1923 or 1924.

Senator MURDOCK. You say he was working under your supervision?

Mr. GAVIN. Yes, sir.

Senator MURDOCK. That is all I have.

Senator O'MAHONEY. You may proceed, Mr. Gavin.

Mr. GAVIN. No. 2. *Costs*: The most thorough study of the cost of mining oil shale is that presented in Bureau of Mines information circular I. C. 7218, "Proposed Methods and Estimated Costs of Mining Oil Shale at Rulison, Colo."

I might mention, Rulison, Colo., was the site of the Bureau of Mines experimental mine and the plants which you see illustrated on my left [indicating].

This circular presents cost studies for mining oil-shale seams of different thickness and richness in that location. Dependent on the thickness of shale to be mined, the mining cost varies from \$1 to \$0.58 per ton. These costs were based on conditions as of 1931 and the authorities in the circular state that all general costs should be multiplied by 1.22 to raise them to the 1942 level.

Other costs of producing crude shale oil and refining this oil into commercial products have not been established so well as mining costs, but on the basis of semicommercial studies made by the Bureau of Mines in work supervised until 1927 by the writer and subsequently by Mr. A. J. Kraemer, of the Bureau of Mines, it is believed that shale oil could be produced from the Colorado deposit mentioned at a cost of between \$2 and \$2.50 per barrel.

No. 3. *Products*: Our knowledge of the yields and characteristics of products from crude shale oil is based almost entirely upon refining methods and specifications of products as of about 1930. There have been revolutionary changes in the science of petroleum refining since that year and it is believed that experimental work based on these new developments would give a much more favorable picture of yields and characteristics than we now have.

Senator O'MAHONEY. I take it that this estimate of \$2 or \$2.50 a barrel is based exclusively upon work that preceded 1928?

Mr. GAVIN. That is right, sir.

Senator O'MAHONEY. Now, have you any reason to believe that it could be produced at a lower cost now, or what is your judgment on that?

Mr. GAVIN. I believe that those figures are substantially right at the present time, sir.

I am doing a little bit of, possibly, optimistic thinking in reaching that conclusion. General costs, of course, have risen since 1930. I am thinking specifically that in the costs of that date there are certain handling costs, the physical handling of the tonnage, and yardage of the oil shale, and the spent shale, that is, the shale after the oil has been removed. There have been developments, perhaps I shouldn't say revolutionary, but of rather great importance, in methods of handling materials, ores, and in the over-all adjustment, taking factors such as reduction of transportation costs by handling with modern methods into consideration, I believe the figure of \$2 to \$2.50 for present-day cost is substantially correct.

Senator O'MAHONEY. What are the principal factors of cost, Mr. Gavin?

Mr. GAVIN. The principal factors are mining, transportation, and—we are speaking now of producing the crude shale oil?

Senator O'MAHONEY. Yes.

Mr. GAVIN. Mining, transportation, and the process of retorting, that is, producing the oil from the mineral matter we call oil shale.

Senator O'MAHONEY. Are mining costs high or low or medium?

Mr. GAVIN. Well, this particular work of the Bureau of Mines which has been presented in detail in the information circular I mentioned was based on the mining of seams of different thickness and consequently, different richness.

The cost determined ranged from approximately \$1 a ton for the thicker and richer seams, to as low as 58 cents for a section, I believe, 106 feet thick, which would yield oil at the rate of something over 25 gallons of oil per ton.

Senator O'MAHONEY. A dollar a ton for mining would represent what per barrel of crude oil produced?

Mr. GAVIN. A dollar a ton for mining, working on that particular seam, would represent—I am guessing just a little bit now—something over a dollar a barrel.

That is, this particular seam would yield somewhat less than a barrel of oil so the cost per barrel would be somewhat more than a dollar.

Senator O'MAHONEY. Now, what is the transportation charge?

Mr. GAVIN. The transportation charge, including in the transportation the cost of breaking the shale to fit it first for transportation, and secondly, to break it to a size sufficiently small to put it in the retorts would be in the neighborhood of 50 cents.

Senator O'MAHONEY. To transport from where?

Mr. GAVIN. To transport from the mine to the retorting site.

In general, the site of the location of the shale itself, is not the most suitable for the installation of retorts. There are such matters as that of water supply, power-plant sites, and the like. At the particular site of our experimental plant, the shale deposit was something over a mile away in a horizontal direction and about 2,500 feet higher.

Senator O'MAHONEY. Now, the retorting charges.

Mr. GAVIN. The retorting charge would be approximately 50 cents per ton.

Senator O'MAHONEY. And that would be——

Mr. GAVIN (interposing). That would add up to about \$2. The figures are rough, sir. Mining costs, I think, have been quite well established. The costs of retorting are not so well known simply because the work was not gone into on as extensive a scale as is necessary to establish costs.

Senator O'MAHONEY. Thank you very much.

Mr. GAVIN. In Mr. Kraemer's statement of October 7, 1942, before a subcommittee on war minerals of the Committee on Public Lands and Surveys, United States Senate, he estimated that gasoline could be produced from the Tertiary oil shale, Colorado, at a total cost of 10.7 cents per gallon exclusive of administrative overhead cost for the refining operation and that the capital cost of a plant to produce 5,750 barrels per day of crude shale oil would be approximately \$10,000,000 or at the rate of \$1,740 per barrel per day crude oil capacity.

On the basis of present knowledge, the writer concurs in these estimates but believes it extremely probable that by the application of new engineering methods and knowledge, these costs may be substantially reduced and as indicated above finished product yields substantially increased.

Senator O'MAHONEY. In terms of manpower, how much employment would be afforded by oil shale refining?

Mr. GAVIN. Without considerable calculation, sir, I would hesitate to say, but it would be plenty.

On this particular basis Mr. Kraemer suggested, a plant to produce 5,750 barrels per day of crude shale oil would involve the mining of something in the order of 10,000 tons a day of shale oil and transporting that to the retorts. The retorting plant itself would not require a very large amount of personnel. I would say that other witnesses are much better qualified than I to indicate how many men it would require to mine 10,000 tons of oil shale per day.

Of course, producing only 6,000 barrels of crude oil per day would be merely a drop in the bucket and, if that is multiplied by quantity to effect a considerable increase to our crude oil production, we would have a lot of mines.

Senator O'MAHONEY. Let me interrupt to suggest to Dr. Fieldner that he give some thought to the question of manpower. The problem of reemployment on full employment arising from demobilization of the armed forces after the war will be with us, and it occurs to me that that is a question which should be weighed carefully in connection with any development of natural resources such as suggested here.

You may proceed, Mr. Gavin.

Mr. GAVIN. Information presently available indicates that the Fischer-Tropsch process using natural gas where gas is available for such purposes is the most favorable method now known of augmenting gasoline supplies. Oil shale is the most favorable source of fuel oil and it has no known uses except for manufacture of oil and its products, whereas coal and natural gas may be used in their natural states.

Gasoline may be produced more cheaply from oil shale than from coal, on the basis of present data and the utilization of newer oil-processing techniques to shale oil refining may result immediately in somewhat more favorable cost figures for shale gasoline production. Inasmuch as natural gas production may be expected to decrease somewhat proportionately to the decrease in petroleum production, the relative importance of oil shale as a source of gasoline may increase with time.

No. 4. *Recommendations*: The most precise work done to date on oil shale and shale oil in the United States is the work of the Bureau of Mines, which was concluded approximately 10 years ago.

Because of the evident impending need for new sources of petroleum-like products and the new engineering knowledge which has become available within the past 10 days, it seems essential that the investigational work so ably conducted previously by the Bureau of Mines be brought up to date by providing semicommercial or pilot plant facilities to enable advantage to be taken of our more recently acquired skills and knowledge.

Senator O'MAHONEY. I suppose I may be justified in assuming that that is an endorsement of the bill before the committee?

Mr. GAVIN. Decidedly so, sir; that is right.

Senator O'MAHONEY. Are there any questions, Senator Murdock?

Senator MURDOCK. I have none.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No.

Senator O'MAHONEY. Thank you very much, Mr. Gavin.

Mr. GAVIN. Thank you.

Senator O'MAHONEY. The next witness is Dr. Charles A. MacQuigg, dean of engineers, Ohio State University.

STATEMENT OF CHARLES ELISON MacQUIGG, DEAN OF ENGINEERING, OHIO STATE UNIVERSITY, COLUMBUS, OHIO

Senator O'MAHONEY. Doctor, you may give your name and position to the reporter, please.

Dr. MacQUIGG. My name is Charles Elison MacQuigg, Dean of Engineering, at Ohio State University, and director of the Engineering Experiment Stations, both at Columbus, Ohio.

Senator O'MAHONEY. How long have you been director of the experiment stations?

Dr. MacQUIGG. Since July of 1937. Prior to that I was in the industrial-research field and practiced metallurgy and metallurgical research.

Senator O'MAHONEY. In what fields does this experiment station operate?

Dr. MacQUIGG. Our purpose, as defined by the law establishing the station in 1913, is to study the resources of the State, the commercial applications, developments, and exploitations of the resources, transportation, and natural facilities.

That happens to be my interest here, Senator. That is, I do not represent any company or anything of that kind. It is my idea to simply come here and make a plea for the enactment of this proposal purely on the basis of its need from the research angle.

Inasmuch as you have already heard many competent witnesses, I would like to save your time by simply reading from my statement portions of it, sort of for the sake of emphasis.

Senator O'MAHONEY. Very well, that will be quite satisfactory, but the entire statement will appear in the record.

Dr. MACQUIGG. Yes, sir.

Senator MURDOCK. May I interrupt? I am very much interested in the statement that you make in connection with the smoke nuisance in Salt Lake City and other cities there.

In the production of liquid fuels from coal, would the residue, what is left, would that constitute a usable fuel for heating homes?

Dr. MACQUIGG. Yes, sir. Dr. Fieldner, of course, can correct me, but it is possible to run these processes with some residual coke and that coke then would constitute a smokeless fuel. That is correct, isn't it, Dr. Fieldner?

Dr. FIELDNER. Yes. I am touching on that in my statement.

Senator MURDOCK. Then I won't press the question further; but I am very much interested in that phase of it.

Dr. MACQUIGG. The so-called repressuring of this gas from the best information I have, is that it is rather unique, in this area, in that the gas can be brought in on the off-peak periods, off-peak periods of consumption and stored in the ground. Because these Clinton sands appear as lozenges or in the form of lenticular formations, that gas can't escape, and these are natural gasometers down in the ground.

The map there on the left shows the distribution of the main gas lines, the heavy black lines and the position. Of course, gentlemen, you understand I am speaking about Ohio now. There may be similar situations elsewhere but I am more familiar with our local situation. One person has described this as the gas granary of the Nation. That is, gas could be stored up there like you store corn in a crib, and made available into the whole central area.

Senator O'MAHONEY. You mean stored in these natural formations?

Dr. MACQUIGG. Yes, sir.

There are, I think, three locations, certainly two—two that I have personally seen—maybe three in the State, where gas is coming. I guess as far as from Texas, and is being pumped down, and those stations are running 24 hours a day, pumping the gas, repressuring it down into the ground, and next winter, when the load comes on it is made available.

Senator O'MAHONEY. How much loss is involved in an operation of that kind?

Dr. MACQUIGG. I understand that, as far as the gas companies can tell, there is no loss at all.

Mr. T. H. Kerr, of our experiment station, is here, and I think he can answer that.

Mr. KERR. There is no loss.

Dr. MACQUIGG. No detectable loss.

That is, in this particular kind of formation.

Senator O'MAHONEY. That is very interesting, I am sure. It means that natural gas could be transported by pipe line from one area of the country and stored in the ground in this lenticular formation.

Dr. MACQUIGG. That is being done, sir. That is quite true. That is an everyday thing there. I don't believe it is being done elsewhere in the Nation, on a big scale at least. It is not done elsewhere, Mr. Kerr?

Mr. KERR. In a few isolated locations, but this is the largest storage I know anything about.

Senator O'MAHONEY. And the original contents of these lozenges, as you call them, of course, have been removed?

Dr. MACQUIGG. Largely, yes.

Senator GURNEY. What is the capacity there, is it unlimited for storage purposes?

Dr. MACQUIGG. Oh, no. Strictly speaking, Senator, it would not be unlimited, because there is a limit to everything, but on the basis at which it is operating today, it is unlimited; yes, sir.

And I suppose that limit, if you pushed it farther and farther, could be raised by going to an adjoining township or an adjoining lens, as it were.

Mr. Kerr, my associate here, has pointed out that using certain designs for the process contemplated—and there again I stand to be corrected by the Bureau of Mines authorities—but I believe there is a very wide range of flexibility in these processes, so that you can design your plant or, at least, operate your plant, with ability to make more or less gas and more or less lube oil, and more or less this and that. I mean, speaking of not gasoline, but actual gas.

That type of plant may be made to have a very profound effect upon the economy of the whole district.

Senator O'MAHONEY. How are you going to make vitamins out of natural gas?

Dr. MACQUIGG. I was told by one of Dr. Fieldner's associates that one of these derivatives—I am not an organic chemist—but I was told it had been determined lately it was a fine source of vitamin E. I may be corrected on that, but I think that is true.

Looking finally to the post-war picture, researches of the type contemplated will place this country on an equal footing with foreign competition.

And it seems to me, from things that have been said here, that we may be facing that very same kind of competition.

Senator O'MAHONEY. Senator Davis, the witness has been talking, to some extent, about a condition that affects Pennsylvania, if you care to ask him any questions.

Senator DAVIS. No. I am just reading what he has already said with the hope that I might be able to ask a question.

Senator O'MAHONEY. Congressman Fenton, do you care to ask any questions?

Congressman FENTON. Not at this time; no.

Congressman RANDOLPH. Mr. Chairman, may I at this time for the record at this point note the presence also of Congressman Beall, of Maryland, who represents a coal-mining district also, and is interested in this subject.

Senator O'MAHONEY. Very happy to have Congressman Beall with us, and the invitation to participate in the questioning is extended to him also, of course.

Congressman BEALL. Thank you.

Senator DAVIS. I don't know how familiar you are with the coking gas that comes from these modern coke ovens. Are they making any progress in taking the excess gas that comes from those ovens and pumping it back into abandoned gas wells?

Dr. MACQUIGG. I have never heard of that being done, sir.

Senator DAVIS. I think they are doing it now in Pennsylvania.

Dr. MACQUIGG. Is that so?

Senator DAVIS. If I am not mistaken, I believe they are. They are buying up the older gas wells in the neighborhood of these modern coke ovens, where they have a surplus of gas, pumping it back into the wells, and improving the gas content.

Dr. MACQUIGG. Mr. Kerr says that is being done at Pittsburgh; so your information is correct, sir.

(The following statement was submitted by Dr. R. R. Sayers for the record:)

One company operating coke ovens in Pennsylvania pumps gas produced during periods of low demand into old abandoned gas wells for storage. These wells are in formations which are tight and there is no loss of gas. When a period of high demand is encountered gas is withdrawn from this storage for use. It has been found that the gas withdrawn has a higher calorific value than the gas pumped in, apparently because of mixing with some natural gas still remaining in the formations.

Senator O'MAHONEY. Senator Murdock, any questions?

Senator MURDOCK. No questions.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No questions.

Senator O'MAHONEY. Thank you very much, Dr. MacQuigg; we are indebted to you for a very stimulating statement.

Dr. MACQUIGG. Thank you.

(The supplemental statement submitted by Dr. MacQuigg is as follows:)

The following reasons may be cited for the enactment of bill S. 1243:

I. IMPENDING SHORTAGES OF LIQUID AND GASEOUS FUELS

Enough reliable information has been accumulated to indicate that the known reserves of petroleum and natural gas in the United States are so limited in extent when compared with our present consumption that in the not distant future our consumption will be of such relation to the reserves as to require other sources of supply much sooner than has heretofore been the general belief.¹ Some authorities have placed this time of the catching up of rate of current use versus developing reserves as low as 13 to 15 years; others decline to name a definite time but admit its relative nearness. Still other persons decline to admit an impending scarcity of petroleum and natural gas and hopefully postpone shortages to an indefinite, long future; the latter group of experts are undoubtedly in the minority. It is not necessary for the present consideration to know definitely what the exact life of the reserves will be. One of the latest statements on this subject is that made by Dr. B. T. Brooks in the New York Times of Sunday, July 18. The gist of Dr. Brooks' statement is that the United States will become an oil-importing nation before long. Suffice it to say that whether the period be 10 years, or 50, the validity of the argument developed here is unaffected.

It might appear from the indefiniteness of the life of the reserves that this question is not of immediate concern and, at the very worst, many years of plenty remain to us respecting our supplies of petroleum and gas. Be this as it may, the arguments presented herein are based entirely upon the fact that the reserves of coal are many hundreds of times greater than the reserves of liquid and gaseous fuels and that sooner or later we must proceed to replace the latter fuels by the former. Proceeding with the picture of the inevitability of eventually deriving our liquid and gaseous fuels from coal, we can justify an experimental plant for research purposes alone. It will be shown, however, that such a plant in certain areas, can reasonably be expected to have utilitarian purposes of wide consequence to its surrounding communities. Admitting at once the lack of commer-

¹ Coals' New Horizons, Coal Age, April 1943, p. 57.

cial feasibility for the products of the plant at present prices for hydrocarbons, nevertheless, we shall try to demonstrate that no time should be permitted to elapse before large scale research is started on our American coals.

Our economic life is definitely built, to a great extent, on the internal combustion engine, and it is, therefore, trite to point out the increasing dependence of Diesel-driven marine and land transportation on gasoline and the heavier liquid fuels; also motor-driven equipment is a *sine qua non* of military matériel, while the necessary control of the air is dependent upon an ample supply of high octane gasoline.

Turning to the post-war economy, it is not any longer a matter of speculation as to what our fuels will be. Much of the mechanical energy needed for our national life will be derived from liquid and gaseous fuels. If in a relatively few years our liquid and gaseous fuels supplies give us increasing concern, it is logical that we must not longer delay planning to use our scientific knowledge for the solution of our problems. It seems self-evident then that we can follow one of very few courses. We can continue to deplete our natural supplies yet remaining in the earth and, in the case of natural gas, continue to regard it only as a fuel instead of a God-given chemical agent, and do nothing to develop technology along clearly indicated lines. Such a course will hasten the day when we must perforce import fuels. On the other hand, we may produce substitutes for natural gas and petroleum. Happily coal can be transformed to liquid and gaseous fuels and for an indefinite future we must rely upon coal.

II. RESEARCH MUST BE DONE NOW

The processes contemplated for further development under sponsorship of this bill, such as coal hydrogenation or gasification through the "water gas" types of reactions, are not in controversy as to their technical feasibility. Vast plants are being operated abroad at this moment for the production of gasoline and other valuable hydrocarbons. What is being proposed for the United States is a concrete study of the applications of the established technology to our own engineering economies and study of further refinements. By constructing the proposed experimental facilities we will, as a Nation, be in a better position to cope with the shortage of certain kinds of fuels, notably petroleum and gas, through the conversion or substitution of our most plentiful form of energy, namely, coal. This substitution, even at increased cost, sooner or later is going to be necessary and justifiable on the basis of our economic situation in which we are already fixed.

As the matter stands today our technicians are somewhat familiar with the details of foreign practices in this art. They do not, however, know the necessary facts relative to the behavior of our numerous types of American coals and the many factors necessary for commercial development by these methods.

III. THIS PROJECT MUST BE GOVERNMENT SPONSORED

Ordinarily, industrial research gambles with some process which is as yet only envisioned or, at best, merely discovered and not at the time fully commercialized. In the present situation the uncertainties attendant upon the usual pattern of industrial research are largely removed because large-scale operations abroad have already demonstrated the entire practicability of the processes; one plant alone in England is producing thousands of barrels of gasoline per day. Therefore, with the removal of the hazards accompanying the average industrial research, this is not a research gamble but a problem in the application of known methods to the solution of questions in our national fuel economy. Moreover, the establishment of this plant would differ from the customary type of industrial development where the element of gain is quite properly present in the financial return to the company or section of industry. The proposed project concerns the welfare of the Nation and is not in the same category as the development of a process whereby a single interest may benefit.

It might be argued that an experimental plant of the type mentioned should be the concern of one of the large American industrial organizations, say a coal association, or a large producer of petroleum products, or a manufacturer of organic chemicals, or some similar industrial interest or group of interests. Such is not the case, because of several factors applying to this specific situation. In the first place, it may well be argued that the cost is too great for any single commercial interest in view of the diffuse nature of the rewards to be reaped in the future by any one interest alone. Since no basic patent protection could be

enjoyed the monetary reward for development by a single company would not be attractive enough in the immediate future to justify the required large expenditure of stockholders' money. Moreover, since the matters to be investigated are so fundamental to the well-being of our national life, it would seem that automatically the problem goes into the domain of the General Government.

If it should be argued that the time element does not press for the immediate development of this plant, such argument may be answered by stating that an experimental plant can be justified as a military necessity. Already we are vexed by the very problems touching the heart of these researches, namely, gas and oil shortage. With a short war the temporary dislocation of civilian life with attendant problems of morale can be postponed for a period; with a long war not only is the civilian situation aggravated but matters of military necessity become infinitely sharper. Chiefly due to transportation difficulties, we are now tasting a situation which, in the not distant future, may well be due to an entirely different cause, namely, scarcity of supply.

IV. COLLATERAL ADVANTAGES OF A RESEARCH PLANT

Compelling reasons in related realms of national welfare justify the immediate conduct of the proposed researches. Among these are the wide social implications beyond the obtaining of technical data on the processes. For example, in certain areas of the Appalachian coal fields the local deposits suffer in competition with the coals of adjoining regions because of characteristics of composition. This results in the unemployment of the miners with attendant lowering of the economic standards in the whole district. (No problem exists in marketing the high-class coals which should be used as they are; the beneficiation of the less marketable fuel is needed.)

These coal deposits are merely awaiting the touch of processes which will make them available and at the same time capitalize on the acute needs for the more desirable types of fuel. As an example of what is meant; We have a certain combination of factors in our area which have been of concern to the Ohio State Engineering Experiment Station. The western fringe of the Appalachian area presents a unique combination of problems; because of the importance of this area from the standpoint of population, war production, tax-paying capacity, and other physical and economic factors, it is almost the solar plexus of the Nation. Some of the reasons why this research is timely for this area are, very briefly (a) the availability in Ohio alone of some 5,430,000,000 tons of coal reserves² with an already developed producing capacity of 30 to 40 million tons of coal per annum. Details of the location and composition of this coal are presented in the accompanying report.³ (b) This area, being the first to develop natural gas, has come to depend heavily on that source of energy for both industrial and domestic use. Because it is such a large consumer of natural gas, exceptional facilities for distribution of this fuel have been set up. Threatened now with shortages, this area becomes strategically most important in connection with the proposed treatment of coals. Numerous benefits can be visualized by switching from coal to derived products; one among them is combating the smoke nuisance in the exceptionally large number of cities over 100,000 population in this zone. Another is the presence of unique geological forms in the Clinton sandstones permitting subterranean storage of gas produced by this technique.

"The Clinton sand in Ohio is unlike the gas-producing sands found elsewhere in the Appalachian area, in that whereas in the States of New York, Pennsylvania, West Virginia, Kentucky, and Tennessee where natural gas is found the producing sands are practically continuous. In Ohio the Clinton sand is what the geologists call lenticular in nature. The productive areas are extremely spotty, varying in size from a few acres supporting a single well to large areas covering several townships. While the spotty area of production is a headache to the wildcatter and the geologist, it has one very definite advantage in that it makes possible the repressuring of the near-depleted wells and the storage of large quantities of gas underground.

"Several such areas in two groups have been so used for several years by the Ohio Fuel Gas Co. and no doubt many other such areas are available among the

² Geological Survey of Ohio, Fourth Series Bulletin, 34.

³ Report of the Facilities in Ohio Favorable to the Location of Proposed Plant for the Hydrogenation and Liquefaction of Coal, T. H. Kerr, Ohio State Engineering Experiment Station, July 1943.

many spots of Clinton and in Ohio. The pipe lines operated in conjunction with these storage areas cross the coal-producing areas of Ohio at many points" (local citation). A unique advantage claimed is that there is practically no loss of gas.

The gas-distribution lines, already mentioned, may be seen on the map and one authority has likened Ohio to the "gas granary" of the Appalachian area. As far as discernible at this moment, future demands for fuel energy are going to capitalize the "convenience factor" of gas and liquid fuels. A price differential is gladly paid by the consumer in recognition of this convenience factor which comes from the form of the fuel.

Mr. T. H. Kerr has pointed out that using certain designs for the process contemplated, this plant could make an appreciable contribution to the gas supply of this whole area by reason of the already existing storage and distribution facilities and the already established demand. This has an immediate bearing on present recognized deficiencies in the general gas supply for this area. Already much of our economic technology is dependent upon the hydrocarbons derived from gas and petroleum. One might almost predict, therefore, that the establishment of this research in a highly industrialized area would many times justify the expenditure by virtue of the contributions made to fundamental industries running the whole gamut from synthetic rubber to vitamins.

V. Looking finally to the post-war picture, researches of the type contemplated will place this country on an equal footing with foreign competition.

Senator O'MAHONEY. The next witness is Mr. C. S. Snodgrass, Foreign Division, Petroleum Administration for War.

**STATEMENT OF C. STRIBLING SNODGRASS, ASSOCIATE DIRECTOR,
FOREIGN DIVISION, PETROLEUM ADMINISTRATOR FOR WAR**

Senator O'MAHONEY. Will you give your name to the reporter?

Mr. SNODGRASS. C. S. Snodgrass, Associate Director, Foreign Division, Petroleum Administration for War.

Senator O'MAHONEY. You may proceed, sir.

Mr. SNODGRASS. I have prepared a short statement on the subject of the production of substitute liquid fuels in European Axis countries.

This subject was covered generally in my statement before a subcommittee of the Committee on Mines and Mining, House of Representatives, at hearings held by Congressman Jennings Randolph in July 1942. In this statement I outlined the development and utilization of the several processes available for the production of liquid fuels from various grades of coal, and pointed out some of the underlying reasons for the development of substitutes in Europe. Further, I submitted as highly desirable that every opportunity be provided for research and development in this important field so that we may know how best to supplement our petroleum resources when the time comes.

The desirability of developing petroleum reserves needs no emphasis here. Statistics show that we are depleting our proven reserves at a rate of about 7 percent per year, whereas the reserves of the rest of the United Nations' world, excluding Russia, are being depleted at a rate of slightly over 1.6 percent per year. In other words, reserves in the United States are being depleted four times as rapidly as are other United Nations' reserves.

In World War I our petroleum resources were supplemented by those from Mexico. Now, in World War II, large offshore requirements are being supplied from other foreign pools, such as Venezuela, Iran, and Iraq. But from what supplementary source will our

needs for the next war be met? The answer is from new discoveries and/or from substitutes.

In looking toward substitutes as a source of future supplies, our attention is naturally drawn to Germany where a 4-year plan was projected in 1936 for the production of synthetic oil from coal in quantity equivalent to their peacetime consumption of some 5,000,000 tons per year of petroleum products. The three main processes upon which their 4-year program was founded were (1) hydrogenation, (2) hydrocarbon synthesis or the Fischer-Tropsch process, (3) coal carbonization or distillation. Some publicity has been given to the solvent extraction of coal and to other processes, but none of these are known to play any significant part in the production of synthetic fuels.

The German chemical and metallurgical industries depend upon bituminous coal from which are derived coke for pig iron, pitch coke for metallurgical electrodes, and certain aromatic constituents of coal tar for dyes, drugs, and explosives.

The production of bituminous coal in Germany in 1935 was reported as 268,000,000 tons; that of brown coal as 172,000,000 tons. Estimating the fuel value of brown coal at 50 percent of that of bituminous coal, the total production of bituminous coal equivalent amounted to about 354,000,000 tons. Some 15 percent of this would be required as raw material to manufacture the estimated production of substitute liquid fuels in European Axis countries today.

Senator O'MAHONEY. We have all seen reports in the press of the deterioration of German gasoline used by the Luftwaffe. Do you know anything about that?

Mr. SNODGRASS. In my opinion, the quality of fuels which have come to our attention, German aviation fuels, have been adequate for the purpose. There again, it comes back to what Mr. Bruce Brown called this morning the team of the engine and the fuel.

Senator O'MAHONEY. Then so far as P. A. W. is concerned, the evidence before that agency does not indicate that German lubricants and gasoline are deteriorating in quality?

Mr. SNODGRASS. Lubricants, yes; but not gasoline. This is my opinion.

Senator O'MAHONEY. I see. Are the lubricants made synthetically too?

Mr. SNODGRASS. Yes; a limited quantity of allegedly high-grade lubricants are made by a highly involved and intricate series of processes from the Fischer-Tropsch raw material.

Senator DAVIS. Germany is not depending upon its oil from coal, is it?

Mr. SNODGRASS. No, Senator. Later on in my statement here I mention the approximate figure, perhaps 50 percent today.

To illustrate the magnitude of plant construction required in the production of these synthetic fuels, it may be pointed out that certain plants reported as under construction in eastern Germany are understood each to occupy an area greater than Central Park; in fact, one of them is understood to cover an area 50 percent greater than Central Park. Another telling comparison is our estimate that the coal utilized in substitute fuel production by the western Axis is approximately the same as the quantity utilized for generating electric power. Ger-

many's investment in synthetic oil plants today is estimated to be on the order of \$2,000,000,000.

In my former statement to the Randolph subcommittee, I noted differences in the characteristics of synthetic and natural petroleum products. Further evidence which has come to hand indicates that wartime pressure on the western Axis has accelerated research and development to the point where substitute liquid fuels of premium quality are now being provided—high grade Diesel oils for their U-boats, and excellent aviation gasoline for the Luftwaffe. This transition from lower grades to the highest grades is significant as a milestone in the development of petroleum substitutes.

The high-temperature carbonization industry in Germany is common to that of other countries. However, its low-temperature coal-distillation industry is noteworthy since it is directed primarily to the utilization of the brown coal deposits of central Germany and the Sudetenland. The moisture content of these lignites is over 50 percent in central Germany and around 30 percent in the Sudetenland—they are low-grade fuels but they are cheaply mined. In the German economy these fuels are distilled for their tar content, and the by-product coke is utilized either in power plants or as raw material for the production of gases for Fischer-Tropsch synthesis. Most of the tar is converted to gasoline or Diesel oil by hydrogenation, with perhaps 10 percent being processed for wax, lubricants, Diesel and fuel oil in refineries which operated before the big expansion.

Senator DAVIS. How does our lignite in North Dakota compare with the lignite you were just describing in Germany?

Mr. SNODGRASS. I will have to pass that question, sir, to Dr. Fieldner, of the Bureau of Mines, whom I believe you will hear from very shortly.

Senator DAVIS. Very well.

Mr. SNODGRASS. The hydrogenation process is highly complicated and may be regarded as a means of converting energy in the form of coal into energy in the form of gasoline in much the same way that a power plant converts coal into electricity. In fact, the thermal efficiency of each is about the same. However, the more efficient application of hydrogenation appears to be the refining of coal tar and certain petroleum oils, and this is the direction of greatest expansion in Germany. It is estimated that over 60 percent of the hydrogenation plant capacity in Axis Europe operates on coal tar or on petroleum feed stocks. It is probable that more coal tar will be utilized as raw material for hydrogenation when and as power plants can be built to utilize the byproduct coke which is produced in distilling the coal.

The integral nature of the development of these processes is indicated by the attached chart which clearly shows the relationship between the low-temperature distillation of coal, the hydrogenation of coal tar, and the utilization of the soft coke as raw material in the Fischer-Tropsch process.

If you care to turn to that chart the processes are indicated in heavy broken lines, these products produced from these processes in the lighter lines.

The coke is processed in the water gas plant and gas is utilized for conversion into the various petroleum products indicated below,

either through the Fischer-Tropsch synthesis or through hydrogen production and the hydrogen of tar or, of course, of coal direct.

In summary, it can be said that Germany, whose internal pre-war sources of liquid fuel supply were entirely inadequate for her purposes, has gone a long way toward making good these deficiencies through the successful carrying out of her ambitious 4-year plan for synthetic plant construction. She has, in fact, not only reached the output called for in that plan, but by the beginning of 1944 will have substantially exceeded it. Barring military damage or destruction, the capacity of these synthetic plants (as supplemented by other sources of oil from coal) will approach 50 percent of the total European-Axis controlled supplies of liquid fuels. As indicated, however, this has only been achieved by the application of long-range planning, by very large investments in plant construction, and by a great expansion of her coal-mining enterprises.

Senator O'MAHONEY. Any questions?

Senator DAVIS. I would just like to ask: How much coke and coal has Germany got within the boundaries of what we call Germany?

Mr. SNODGRASS. Senator, I don't have the figures in my mind on that. I believe you will find that in other testimony. have it in mind.

Senator DAVIS. All right.

Senator O'MAHONEY. Mr. Snodgrass, we are very much indebted to you. Thank you very much.

The Alien Property Custodian is represented here this afternoon by witnesses who will tell the committee about the processes that are being utilized through the Alien Property Custodian by the American Lurgi Corporation.

Gentlemen, will you be good enough to come forward?

STATEMENT OF JOHN F. O'MAHONY, CONSULTANT, OFFICE OF THE ALIEN PROPERTY CUSTODIAN, NEW YORK, N. Y.

Senator O'MAHONEY. Will you give your name to the reporter, please?

Mr. O'MAHONY. John F. O'Mahony, of the Alien Property Custodian's Office.

Senator O'MAHONEY. How do you spell your last name, sir?

Mr. O'MAHONY. O'-M-a-h-o-n-y.

Senator O'MAHONEY. You don't spell it as the chairman spells his, but you pronounce it the same.

Mr. O'MAHONY. Yes, sir.

Senator O'MAHONEY. Very well, sir.

Mr. O'MAHONY. Mr. Chairman and members of the committee, I represent the Alien Property Custodian and his interest in a corporation which he vested last year. It was entirely owned by Germans and is now vested in its entirety by the Custodian. It is an engineering concern very much concerned with heavy chemicals.

One of their processes is the Lurgi process, low-temperature carbonization of fuel. It is actively conducted here in this country and to a great extent in Germany. It is probably responsible for most of the synthetic gasoline that is being produced for the German war effort.

Senator GURNEY. In Germany.

Mr. O'MAHONY. Yes, sir.

The Custodian had Dr. Mueller come here, he being the president of the corporation, and very well informed, he probably knows more about the Lurgi process than anybody in this country.

Senator O'MAHONEY. Is this a different process from those which have been discussed here during this session?

Mr. O'MAHONY. Oh, indeed, it is a different process.

Senator O'MAHONEY. When did the Alien Property Custodian take it over?

Mr. O'MAHONY. Last November, 1942.

Senator O'MAHONEY. It was an individual process that was patented in this country?

Mr. O'MAHONY. I think, Senator, the patent had run out. It has been in use about 40 years.

Senator O'MAHONEY. How did the Alien Property Custodian come to take over the company?

Mr. O'MAHONY. For the reason that it was owned by German interests.

Senator O'MAHONEY. By German individuals or by German corporations?

Mr. O'MAHONY. By a German corporation. This was a subsidiary of the Lurgi Co. in Germany—Metall-Gesellschaft.

Senator O'MAHONEY. Was it associated or allied in any way with I. G. Farbenindustrie?

Mr. O'MAHONY. I believe that the hydrogenation was the I. G. Farbenindustrie process in conjunction with the Lurgi process of low-temperature carbonization.

Senator O'MAHONEY. How many plants have they in the United States?

Mr. O'MAHONY. They have one now, in North Dakota, and it is being successfully operated now, profitably, and is amortizing its loan with the R. F. C.

Senator O'MAHONEY. Where is it operated?

Mr. O'MAHONY. It is operated in Dickinson, N. Dak. It is now in operation.

Senator O'MAHONEY. It has an R. F. C. loan?

Mr. O'MAHONY. Yes, sir.

Senator O'MAHONEY. When did it get that loan?

Mr. O'MAHONY. Dr. Mueller can give you all the particulars on that loan.

Senator O'MAHONEY. Was that loan made before or after the Alien Property Custodian took it over?

Mr. O'MAHONY. Before.

Senator O'MAHONEY. What is the capacity?

Mr. O'MAHONY. I would prefer to have Dr. Mueller answer that.

Senator O'MAHONEY. Very well.

Mr. O'MAHONY. If you are ready to call him, he is here.

Senator O'MAHONEY. There is nothing more that you have to add?

Mr. O'MAHONY. Nothing.

Senator O'MAHONEY. Any questions?

(No response.)

Senator O'MAHONEY. Thank you.

Dr. Mueller, you may have that chair, please.

STATEMENT OF FRANK MUELLER, PRESIDENT, AMERICAN
LURGI CORPORATION, NEW YORK, N. Y.

Senator O'MAHONEY. Dr. Mueller, give your name to the reporter.

Dr. MUELLER. Frank Mueller.

Senator O'MAHONEY. How long have you lived in the United States?

Dr. MUELLER. For 22 years now, sir.

Senator O'MAHONEY. Are you a citizen of the United States?

Dr. MUELLER. Yes, sir; for 15 years.

Senator O'MAHONEY. A native of what country?

Dr. MUELLER. Of Bremen, Germany, but my family came here in 1872; it just so happens that my mother went back to Germany.

Senator O'MAHONEY. How long have you been associated with this company?

Dr. MUELLER. For 30 years.

Senator O'MAHONEY. What is your scientific training?

Dr. MUELLER. I am a chemical engineer and I specialize in carbonization of coal, and so on and so forth.

Senator O'MAHONEY. Where were you trained?

Dr. MUELLER. In Leipsig, Germany.

Senator O'MAHONEY. How long ago, may I ask you?

Dr. MUELLER. I got my doctor's degree in 1910.

Senator O'MAHONEY. And how long have you been associated with this company?

Dr. MUELLER. I formed this company, the American Lurgi Corporation, and I was associated with the German company since 1911.

Senator O'MAHONEY. Who are the owners of the German company?

Dr. MUELLER. There are no owners. It is a corporation.

Senator O'MAHONEY. Well, who controls the corporation?

Dr. MUELLER. Nobody controls the corporation. It is like the United States Steel Corporation.

Senator O'MAHONEY. Well, I think the United States Steel Corporation is controlled.

Dr. MUELLER. In a way it was controlled by a family by the name of Merton, who originally came, the grandfather came from England.

Senator O'MAHONEY. I am talking about the German company.

Dr. MUELLER. That is right.

Senator O'MAHONEY. Is that associated with any of the large German chemical or industrial corporations?

Dr. MUELLER. No. The company is so large that we didn't need to associate with anybody. Senator, when I was last in Germany we had about a thousand engineers and chemists in our employ.

Senator O'MAHONEY. How many stockholders did you have?

Dr. MUELLER. Oh, thousands.

Senator DAVIS. Who were the principal stockholders?

Dr. MUELLER. Formerly the Merton family, but unfortunately they had to leave Germany on account of being non-Aryan.

Senator O'MAHONEY. When did they leave?

Dr. MUELLER. Dr. Alfred Merton left in 1935 and Dr. Richard Merton didn't leave until he was expelled.

Senator O'MAHONEY. What became of the company?

Dr. MUELLER. The company exists as always.

Senator O'MAHONEY. Is it now dominated by the Nazi government?

Dr. MUELLER. No, sir.

Senator O'MAHONEY. You mean it is operating independently of the Nazi government?

Dr. MUELLER. Yes, sir; absolutely.

Senator O'MAHONEY. And engaged in the manufacture of synthetic fuels?

Dr. MUELLER. Oh, no. That is just one sideline. You see, the Lurgi Corporation is a subsidiary of the so-called Metall-Gesellschaft, which means "metal company." That is, the metal company of Germany, let's say of Europe, formerly part owner of the American Metal Co., and whose share was taken over by the Alien Property Custodian in 1917.

Now then, in the period from 1918 to 1938 the technical department of the Metall-Gesellschaft, which is called the Lurgi Corporation, developed all these new processes, one of them the low-temperature carbonization.

Now, we built plants here, one in Dickinson, N. Dak., and one in Saskatchewan. This process has become very important for the manufacture of synthetic gasoline and oils. In 1936, when I was there, they treated about 60,000 tons of coal per day in these carbonizers, and we think that now the daily capacity has reached something like 100,000 tons, maybe more.

We have tested a great number of coals in the country, particularly in the State of Utah, for the reason that the Utah coal is much richer in tar than the lignite which we are treating in North Dakota.

In the tests which we made, we had some four coals shipped to Germany and tested. We have the complete analysis and we know that they can be treated by our process and that the tar can be extracted and that a high-grade smokeless fuel can be produced.

Senator DAVIS. Mr. Chairman, may I ask a question?

Senator O'MAHONEY. Surely.

Senator DAVIS. I didn't quite understand what he said.

How does the Dakota lignite compare with the German brown coal as a source of synthetic gasoline?

Dr. MUELLER. I would say it is about the same. You will not find two mines which give you the same lignite or coal. They are all different. They are alike principally. In other words, they are very low in tar. Very low in tar, both. Both the brown coal and the lignite.

Senator DAVIS. Well, it is profitable for the German concerns to produce gasoline from their brown coal, is it not?

Dr. MUELLER. No, Senator. I wouldn't say it is profitable; but you must not overlook the fact that Germany had an import duty on each gallon of gasoline which she bought. For instance, from the United States. All right. You take that off and then they charged every motorist let's say 2 pfennig for each gallon or for each liter of artificial gasoline which the motorist bought and this added up to quite a few marks per year, and this money was used to write off the investment in these artificial gasoline plants.

Now, it is the same with synthetic nitrogen, and the same with synthetic rubber. None of these plants paid from the beginning.

Senator MURDOCK. Mr. Chairman, may I ask a question?

Senator O'MAHONEY. Surely.

Senator MURDOCK. Did I understand you to say that the Utah coals that you had investigated were better and more usable or adaptable to your process that is now operating in North Dakota than the coals of North Dakota?

Dr. MUELLER. Oh, yes. I have some samples here. Would you like to see them?

Congressman RANDOLPH. Yes.

Senator O'MAHONEY. May I ask you while you are opening the box, Dr. Mueller, if you ever had the superior coals of Wyoming tested?

Dr. MUELLER. Yes, sir. I took samples myself of the Kemmerer mine.

Senator O'MAHONEY. And how did they work out?

Dr. MUELLER. Wonderful. But, unfortunately, Senator, you cannot feed briquettes to cows.

Senator DAVIS. But the coals in Pennsylvania and West Virginia are very superior?

Dr. MUELLER. I wouldn't touch them.

Congressman RANDOLPH. For what reason?

Dr. MUELLER. They are good enough as they are.

This [indicating] is the North Dakota lignite after it has been treated in the Lurgi carbonizer. All the water and tar has been driven out. This is the tar, in this bottle. We take this tar and distill it. We make two products—oils. This is one of them [indicating].

Senator O'MAHONEY. That is made from the tar?

Dr. MUELLER. Yes, sir. And the pitch. We take the pitch and mix it with the brown tar and make a briquette. This [indicating] is the smokeless fuel.

Senator MURDOCK. Did you know about the Utah and the Wyoming coals prior to locating in North Dakota?

Dr. MUELLER. No, sir. We developed this process originally for lignite. Then we found out that the North Dakota lignite is very poor, so we went out to Wyoming and Utah and we prepared a full report to make Salt Lake City smokeless and make money at the same time.

Senator O'MAHONEY. You have been making money?

Dr. MUELLER. Yes; we always made money.

Senator O'MAHONEY. May I ask you then what the cost of production is per gallon?

Dr. MUELLER. Well, of course, we were primarily interested in the briquette, and with proper management, with a good mine, in North Dakota, we can make a ton of briquette for about \$6.

Senator O'MAHONEY. Of course, that is coal.

Dr. MUELLER. That is coal.

Senator O'MAHONEY. Dehydrated?

Dr. MUELLER. Well, it is briquetted.

Senator O'MAHONEY. Isn't that what briquetting means?

Dr. MUELLER. No; dehydrating comes first, and then comes briquetting.

Senator O'MAHONEY. Yes; it is a method of making a very moist coal more usable as a fuel, is it not?

Dr. MUELLER. Exactly.

Senator O'MAHONEY. Are we to understand that your principal product is the briquetting?

Dr. MUELLER. Originally it was. Now, the principal product can be the tar, and if you hydrogenate the tar, you get your liquid synthetic fuels.

Senator O'MAHONEY. Are you producing tar at the moment?

Dr. MUELLER. Yes.

Senator O'MAHONEY. And do you have a market for tar?

Dr. MUELLER. We have a market for the oils and for the pitch; yes.

Senator O'MAHONEY. How much do you produce?

Dr. MUELLER. We treat about 500 tons and recover about 15 to 20 tons of tar.

Senator O'MAHONEY. For what purpose is that tar used?

Dr. MUELLER. Creosoting.

Senator O'MAHONEY. Then do you make any oil?

Dr. MUELLER. Yes.

Senator O'MAHONEY. How much?

Dr. MUELLER. Mr. Wheeler, who will follow me, is more familiar with that. But, Senator, it occurs to us since these two plants are in operation, and we have the tar, we think that with very little expense these tars can be hydrogenated and can give you the answer to your question here.

Senator O'MAHONEY. Then, as I understand it, at the present time you are not hydrogenating the tar?

Dr. MUELLER. We are not hydrogenating the tar but we are producing the tar.

Senator O'MAHONEY. And the oil you make is merely an incidental byproduct of the principal operation of making briquettes?

Dr. MUELLER. Correct; but we couldn't exist without the oils; it would not pay.

Senator O'MAHONEY. You don't make gasoline?

Dr. MUELLER. Oh, no; but we can make gasoline.

Senator O'MAHONEY. How does this oil compare with the oil from petroleum?

Dr. MUELLER. Very favorably. Otherwise, we could not sell it. It is a very competitive market. As I say, our corporation is organized to design, build, and operate these low-temperature carbonization plants.

Senator O'MAHONEY. With what part of the process of refining petroleum does this product compare?

Dr. MUELLER. Well, we only deliver the tar, we make the tar and hand the tar over to the hydrogenation plant. That is what we have done in Germany and that is what could be done here.

Senator O'MAHONEY. I am talking about what you do in North Dakota.

Dr. MUELLER. We just distill the tar, keep the pitch for ourselves, and sell the oils.

Senator O'MAHONEY. And how much oil do you produce?

Dr. MUELLER. Mr. Wheeler, will you answer that?

Mr. WHEELER. About 800 gallons a day.

Dr. MUELLER. And we also make phenols and resins.

Senator O'MAHONEY. How many patents do you have?

Dr. MUELLER. We have a great number of patents, but we do not sell patents. We sell engineering service.

Senator O'MAHONEY. I am thinking in terms of the patent itself.

Dr. MUELLER. Yes.

Senator O'MAHONEY. There are a great many products of coal; isn't that right?

Dr. MUELLER. That is right.

Senator O'MAHONEY. And you make a great many in this operation in North Dakota?

Dr. MUELLER. Yes, sir.

Senator O'MAHONEY. How many?

Dr. MUELLER. Well, we can make more than we do now.

Senator O'MAHONEY. I know that, but how many do you actually make?

Dr. MUELLER. What would you say, Mr. Wheeler?

Mr. WHEELER. What was the question?

Dr. MUELLER. How many products do we make.

Mr. WHEELER. Three products; two that are marketed, briquets and creosote oil.

The pitch is used as a binder in making the briquets.

Senator O'MAHONEY. Then this phenol that Dr. Mueller displays is just an experimental product?

Dr. MUELLER. No, sir; the phenol is contained in the creosote oil, and the company gets a very nice premium for its creosote oil, because of its high phenol content.

Now, by further refining the phenols can be taken out and used to make plastics, but the company is not doing that at the present time.

Senator O'MAHONEY. What I am trying to determine is how many products are actually turned out at this particular plant, not how many products could be made out of the materials which you do produce, you understand.

I take it, therefore, that the phenol which Dr. Mueller has just exhibited to us is really not a product of this particular enterprise?

Dr. MUELLER. That is correct.

Senator O'MAHONEY. It was made somewhere else out of this material?

Dr. MUELLER. That is correct.

Senator O'MAHONEY. So that there are, in fact, only two products made in this particular factory?

Dr. MUELLER. Yes; smokeless fuel, and the tar and the creosote oils.

Senator O'MAHONEY. Now, getting back to the patents; how many patents does this corporation or the alien property custodian own?

Dr. MUELLER. On the low-temperature carbonization process, about 15 to 20.

Senator O'MAHONEY. How many patents are you using in this process?

Dr. MUELLER. Only one.

Senator O'MAHONEY. Are you using a patent for producing gasoline or oil from the coal?

Dr. MUELLER. No, sir.

Senator O'MAHONEY. You do not have such a patent?

Dr. MUELLER. No, sir.

Senator O'MAHONEY. So that your operation is primarily an operation for the manufacture of briquets and tar?

Dr. MUELLER. Tar; yes.

Senator O'MAHONEY. Therefore, you have no experience to give us on the manufacture of gasoline?

Dr. MUELLER. From tar; no. I know where to get the information.

Senator O'MAHONEY. Yes; do you have any experience to give us on the manufacture of gasoline from any product under your charge?

Dr. MUELLER. No; we never did that. We confined ourselves strictly to the carbonization.

Senator O'MAHONEY. And you have no patents of which the Bureau of Mines could make use in making out a program visualized in this bill?

Dr. MUELLER. No; except using our tar.

Senator O'MAHONEY. Except using your tar?

Dr. MUELLER. That is right. By using low-temperature tars, which are being used in Germany.

Senator O'MAHONEY. Then what you are suggesting to us is that the low-temperature tars which are made out of this product of yours, out of this coal by your process, would be very well suited to the manufacture of gasoline?

Dr. MUELLER. Definitely. That is why we came here.

Senator O'MAHONEY. All right, sir.

I have been asking you a lot of questions and have probably interrupted you in your story.

Dr. MUELLER. There is one more thing I would like to tell you. The Boykin committee of the House is working with us and we are planning to carry out large-scale experiments together with a large utility corporation to manufacture hydrogen from this tar, by using our briquettes, and we hope we will have an answer in about 4 to 6 weeks to that question.

Senator O'MAHONEY. Are you familiar with the Fischer-Tropsch process?

Dr. MUELLER. I have seen it, but wouldn't call myself an expert.

Senator O'MAHONEY. Do you know whether the synthetic gas which is used in that process could be produced from the lignite coals of North Dakota or the high-grade superior coals of Utah and Wyoming?

Dr. MUELLER. Whether gasoline could be produced?

Senator O'MAHONEY. No; whether this synthetic gas which is used in the Fischer-Tropsch process could be manufactured.

Dr. MUELLER. Yes; sure; that is what we are doing.

Senator O'MAHONEY. Are you making that?

Dr. MUELLER. Over there; yes.

Senator O'MAHONEY. Over in Germany?

Dr. MUELLER. Yes; but not here.

Senator O'MAHONEY. Well, in Germany, at what cost is it produced?

Dr. MUELLER. That I couldn't tell you. That they would not tell me.

Senator O'MAHONEY. Do you know whether or not it is an economical process?

Dr. MUELLER. Under the circumstances it might be; yes, because, as I say, they take off the import duty, which is very high, always was very high, and then they put on two or three pfennigs per liter and thereby they subsidize the manufacture of the synthetic gasoline.

Senator O'MAHONEY. Were you, yourself, engaged in the production of any of these oils in Germany?

Dr. MUELLER. No.

Senator O'MAHONEY. You just observed the process?

Dr. MUELLER. Particularly our process; yes.

Senator O'MAHONEY. But your part was not the manufacture of oil or gasoline?

Dr. MUELLER. No.

Senator O'MAHONEY. So that you are not familiar with that and you cannot testify to this committee from your personal knowledge about it?

Dr. MUELLER. No, sir; that I could not do.

Senator GURNEY. I see you have more samples there. What are they?

Dr. MUELLER. This is Utah coal before and after carbonizing [indicating]. You see the entirely different structure. It is hard; doesn't crumble.

Senator GURNEY. Well, you wouldn't be here today, as I understand it, unless you felt you had some information that would be helpful in making gasoline out of coal; is that right?

Dr. MUELLER. Yes, sir.

Senator GURNEY. Have you given us that information?

Dr. MUELLER. Well, as I said, we are the organization that can build these low-temperature carbonization plants, for the manufacture of tar, which then can be used to make gasoline and oil.

Senator O'MAHONEY. Did I understand you to say that you are making in North Dakota at the Dickinson plant about 800 gallons of oil a day from about 500 tons of coal?

Dr. MUELLER. That is about it.

Senator O'MAHONEY. Now, what process do you use in doing it?

Dr. MUELLER. Mr. Wheeler, would you mind explaining that?

Senator O'MAHONEY. Mr. Wheeler, do you care to answer that question?

Mr. WHEELER. Yes, sir.

At Dickinson, part of the coal, the 500 tons you speak of, is burned up in the power plant in generating power to operate the mine and the briquetting and carbonizing plant. There is really about 400 tons of coal that goes to the carbonizer when the plant is in full operation and out of that about 1,600 gallons of tar per day is produced, which is distilled in what is called a batch still into creosote oil and pitch, about half and half, and the pitch is used as a binder in making briquettes and the oil is sold in the open market as creosote oil.

Senator O'MAHONEY. I was interested in the process which is used.

Mr. WHEELER. The process of distilling is simply in a batch still.

Mr. O'MAHONEY. That is not a patented process?

Mr. WHEELER. No.

Senator O'MAHONEY. Is that process available to anybody who is willing to put up the investment necessary to build such a plant?

Mr. WHEELER. Yes, sir.

Senator O'MAHONEY. So that there is nothing that is being used by way of process or patent in this plant which is not also available to the Bureau of Mines or to any other organization that might undertake the same sort of work?

Mr. WHEELER. Well, the furnace in which the coal is carbonized is a patented furnace. Whether those patents have run out I am not able to say.

Senator O'MAHONEY. Patented by whom?

Mr. WHEELER. The patents were owned by the Lurgi Corporation.

Senator O'MAHONEY. Were those patents taken over by the Alien Property Custodian?

Mr. WHEELER. Well, Mr. O'Mahony can answer that better than I.

Mr. O'MAHONY. They are not part of the patent pool. The patents still remain with the company because the company is still an operating company within the office of the custodian.

Senator O'MAHONEY. Then I take it what has happened has been that the Alien Property Custodian took over the company?

Mr. O'MAHONY. Yes; and the patents, of course, still stay with the company; but, you see, the policy of the custodian is to take all patents and processes and throw them into what is known as a patent pool, which is made available to any American citizen, upon the payment of a small fee.

Senator O'MAHONEY. That was my understanding. For example, I was of the impression that if the Alien Property Custodian had any patent for the hydrogenation of coal that those patents would be available to the Bureau of Mines or to any other user upon terms laid down by the Alien Property Custodian.

Mr. O'MAHONY. That is right.

Senator O'MAHONEY. Dr. Mueller, as I said, I am fearful that we interrupted you by our questions. If you have something more to tell us now, you may do so.

Senator DAVIS. May I ask the doctor a question before you pass on to another subject?

Senator O'MAHONEY. Yes.

Senator DAVIS. Doctor, what are the B. t. u.'s of that briquette?

Dr. MUELLER. About 13,500, and practically smokeless and odorless.

Senator O'MAHONEY. Dr. Fieldner, did you see the briquette?

Dr. FIELDNER. Yes, sir; I have some on my desk in my office and I have seen this plant.

Senator O'MAHONEY. Is there anything else that you care to add?

Dr. MUELLER. No.

Senator O'MAHONEY. Are there any questions?

Dr. MACQUIGG. Mr. Chairman, I would like to ask a question at this time if it is in order.

Senator O'MAHONEY. Surely.

Dr. MACQUIGG. As I visualize these processes there is practically no—within reason—hardly any relation of interrelationships chemically, and I have seen the statement printed that the Lurgi people were in the German Reich, or one of the occupied countries, and have produced a very cheap oxygen for, as I recall the statement, something like 12 cents a thousand cubic feet.

Do you know about that, Dr. Mueller?

Dr. MUELLER. I have seen the statement, too.

Dr. MACQUIGG. But you are not familiar with the details?

Dr. MUELLER. We don't have any details on that. That is a post-war development.

Senator O'MAHONEY. Congressman Randolph?

Congressman RANDOLPH. No questions.

Senator O'MAHONEY. Mr. Fenton?

Congressman FENTON. Doctor, did I understand you to say that the company you now represent is a subsidiary to a German parent company?

Dr. MUELLER. It used to be.

Congressman FENTON. Are there any American citizen stockholders of your company?

Dr. MUELLER. No; the only stockholder is the Alien Property Custodian.

Congressman FENTON. Who received the loan from the R. F. C., you?

Dr. MUELLER. We didn't receive any loan. The Lehigh Briquetting Co. received the loan.

Congressman FENTON. How much was that?

Dr. MUELLER. \$400,000; in 1936.

Senator O'MAHONEY. What is the Lehigh Briquetting Co.?

Dr. MUELLER. That is the plant for operating the Lurgi process in North Dakota.

Senator O'MAHONEY. How is it affiliated with the American Lurgi Corporation?

Dr. MUELLER. Not at all. We built the plant for them, got our money, and they manage their own plant.

Senator O'MAHONEY. Then it isn't the American Lurgi Co. that makes these briquettes?

Dr. MUELLER. No; we don't make any briquettes, but we told them how.

I would like to point out, Senator, that we have certain experience in this field, and we are here to offer our full cooperation, throw open our files, and give you any suggestions.

Senator O'MAHONEY. I take it you feel, as a scientist and one who has been experienced in handling coal, that it is a desirable and feasible thing to proceed with the hydrogenation of coal oil shale and natural gas for the manufacture of gasoline and oil?

Dr. MUELLER. Yes, sir.

Senator O'MAHONEY. Do you recommend that policy?

Dr. MUELLER. I definitely recommend that policy, but I would also like to point out that I would like you to give serious consideration to our process because it works so well in Germany.

Senator O'MAHONEY. I would like to have you describe that process, if you will, so that we will know what it is.

Dr. MUELLER. Well, it is simply for the hydrogenation of the tars.

Senator O'MAHONEY. That is not the Fischer-Tropsch process?

Dr. MUELLER. No.

Senator O'MAHONEY. Nor is it the Bergius process?

Dr. MUELLER. Why, yes.

Senator O'MAHONEY. It is?

Dr. MUELLER. Yes. We work together, on the other side, the whole company, let's say, works together with the I. G. They make for them the tar, and they take the tars, hydrogenate them, and make the lubricating oils and the gasoline; and the same thing should be done over here. Of course, we can only contribute our share.

Senator O'MAHONEY. My questions have all been intended to develop one simple fact, as to whether or not you have a process which

is different from those which have been discussed here during this hearing.

Dr. MUELLER. Why, we are the only ones that have commercial plants on this side of the water working under the Lurgi low temperature process and producing these tars which are very essential.

Senator O'MAHONEY. That may be very true, but that isn't what I am trying to discover. I want to know whether you have, through your corporation, or otherwise, control of any process for the hydrogenation of coal different from the processes which have been discussed at this hearing.

Dr. MUELLER. No.

Senator O'MAHONEY. The answer is no?

Dr. MUELLER. The answer is no.

Senator O'MAHONEY. All right, sir. Are there any other questions?

Dr. FIELDNER. May I ask Dr. Mueller a question, Mr. Chairman?

Senator O'MAHONEY. Surely.

Dr. FIELDNER. Dr. Mueller, in applying the Lurgi process in Germany, is the brown coal put into the apparatus in its raw state, or is it first dried, or is it briquetted?

Dr. MUELLER. Oh, no; it is put in as it is, in its raw state.

Dr. FIELDNER. And it comes out of the carbonizer as a char.

Dr. MUELLER. Yes, sir. Small pieces.

Dr. FIELDNER. Now, in Dakota you take those small pieces, grind them up, further mix them with pitch, and press them into the briquettes?

Dr. MUELLER. Yes.

Dr. FIELDNER. In Germany is that char used in the Fischer-Tropsch plants for making water gas to make gasoline?

Dr. MUELLER. Yes, sir.

Dr. FIELDNER. And they use the char?

Dr. MUELLER. That is right.

Dr. FIELDNER. Do they use it in its loose state or do they briquette it?

Dr. MUELLER. We think they briquette it, and that is a test we are going to make, Dr. Fieldner.

Dr. FIELDNER. Do you think that briquette—

Dr. MUELLER (interposing). Because the char is too light.

Dr. FIELDNER. You couldn't blow the air through it?

Dr. MUELLER. I don't think so.

Dr. FIELDNER. But do you think that they briquette the raw brown coal and then carbonize it?

Dr. MUELLER. I don't think so. They briquette the char.

Dr. FIELDNER. And then put the char in the water gas machines?

Dr. MUELLER. That is right.

Dr. FIELDNER. And that is what should be done in this country?

Dr. MUELLER. That is my recommendation.

Dr. FIELDNER. Of course, the brown coal and the lignite would be practically the same way after they are briquetted.

Dr. MUELLER. Oh, yes; you know that.

Congressman RANDOLPH. May I return to a question of Congressman Fenton, Mr. Chairman?

Senator O'MAHONEY. Yes.

Congressman RANDOLPH. I want to clearly understand and the record show to what company the R. F. C. loan in 1936 was made.

Dr. MUELLER. To the Lehigh Briquetting Co.

Congressman RANDOLPH. Was that a company organized in the United States?

Dr. MUELLER. In the United States; in the State of North Dakota in the year of 1929.

Congressman RANDOLPH. Incorporated under the laws of that State, or under the laws of Delaware, or some other State?

Dr. MUELLER. Under that State.

Congressman RANDOLPH. Are you employed by that company?

Dr. MUELLER. Oh, no.

Congressman RANDOLPH. You have no connection with the company?

Dr. MUELLER. No connection with the company.

Congressman RANDOLPH. Who is the president of the company that received the loan?

Dr. MUELLER. In those days—I don't know whether he was the president, but the man who came to Washington and got the loan was Mr. K. A. Loven.

Congressman RANDOLPH. Is he a resident of North Dakota?

Dr. MUELLER. In those days he was. Now he is in Minneapolis.

Congressman RANDOLPH. Is that strictly an American company?

Dr. MUELLER. Yes.

Congressman RANDOLPH. Simply using a process which you have developed?

Dr. MUELLER. We designed the plant for them, built it for them, and turned it over to them.

Congressman RANDOLPH. Do you know whether that loan has been repaid?

Dr. MUELLER. They are repaying it now at the rate of \$4,000 a month, as I understand.

Congressman RANDOLPH. \$4,000 a month?

Dr. MUELLER. Yes, sir.

Congressman RANDOLPH. When did they start to pay?

Dr. MUELLER. Recently. I understand a few months ago. It was considered a very bad loan and now it is considered a good loan.

Senator O'MAHONEY. Are there any other questions?

(No response.)

Thank you very much, Doctor.

Mr. Wheeler, will you come forward, please.

**STATEMENT OF WALTER H. WHEELER, CONSULTING ENGINEER,
MINNEAPOLIS, MINN.**

Senator O'MAHONEY. Mr. Wheeler, will you give your name to the reporter?

Mr. WHEELER. Walter H. Wheeler. I am a consulting engineer with offices in Minneapolis, Minn., and have been in practice for the last 30 years there. My work includes preliminary investigations, appraisals, reports, designs, plans, and specifications, supervision of construction of industrial plants of various types and other projects.

In 1934 I was engaged by the Lehigh Briquetting Co. as their consulting engineer to make a study of the plant which they had built, using the Lurgi process with a view to putting the plant on a commercial basis and also for the purpose of making an appraisal of the plant to be presented to the Reconstruction Finance Corporation in connection with their application for a loan.

Senator O'MAHONEY. When you speak of the Lurgi process, what do you mean?

Mr. WHEELER. The Lurgi process is the carbonizing process whereby the coal is carbonized into char and the gases and volatiles are driven off and cleaned to obtain the tar and the gas returned to the furnace to furnish the fuel for carrying on the process, and also for cooling the char as it comes out of the carbonizer.

Senator O'MAHONEY. Is that any different from other processes used to obtain the same result?

Mr. WHEELER. Yes, sir; very different.

Senator O'MAHONEY. Is it a patented process?

Mr. WHEELER. I understand—it was patented and the Lehigh Briquetting Co. paid the Lurgi Corporation \$30,000 for the use of the process.

Senator O'MAHONEY. And was that process taken over by the Alien Property Custodian?

Mr. WHEELER. Well, he will have to answer that question, Senator. I am not familiar with that myself.

Senator O'MAHONEY. Mr. O'Mahony, was the Lurgi process itself taken over by the Alien Property Custodian?

Mr. O'MAHONY. No.

Senator O'MAHONEY. Just the company?

Mr. O'MAHONY. That is right. All the patents and processes still remain with the company.

Senator O'MAHONEY. This Lurgi process is not a process for making oils or gasoline but a process for treating the coal?

Mr. WHEELER. And producing low temperature tar, which other witnesses here have called your attention to as being used as a principal basis for synthetic oil and gasoline in Germany.

Senator O'MAHONEY. Yes, sir.

Mr. WHEELER. And this plant in North Dakota, I believe, is the only low temperature carbonizing plant in the United States, so far as I know. I have a picture here of it which you might be interested in looking at. I have numbered the items on the picture so that you can identify them. No. 1 is the dryer and carbonizer into which the coal is charged and dried and carbonized.

No. 2 is the gas-cleaning plant where the tar is removed from the gas, the gas then returned to the carbonizer and dried.

No. 3 is the char storage and briquetting plant.

No. 4 is the briquette-cooling plant.

No. 5 is the briquette-loading bin.

Senator O'MAHONEY. Is that the tar plant?

Mr. WHEELER. No. The tar distillation plant does not show in this picture. It is behind these other structures.

Senator O'MAHONEY. Is there any plant there for making oil?

Mr. WHEELER. Cresote oil is made in the tar distillation plant. Now, after you get your tar, you can do a number of things with it. You can hydrogenate it and make synthetic oil and gasoline, or you

can distill it into pitch and creosote oil, which, in this country at the present time is the commercial thing to do.

Senator O'MAHONEY. Now, the 800 gallons of oil made from the 400 or 500 tons of coal of which you speak, is it creosote oil?

Mr. WHEELER. That is right.

Senator O'MAHONEY. That is a rather high product, isn't it?

Mr. WHEELER. High value?

Senator O'MAHONEY. I mean, a rather large amount of oil to get out of so many tons of coal.

Mr. WHEELER. No; the lignite coals in North Dakota contain a rather small amount of tar or oil. I have been making an investigation in Utah for the purpose of determining whether or not a plant of this type would be commercially feasible in the State of Utah to produce smokeless fuel and tar as a byproduct, and while the information I have gathered is naturally the property of my client and confidential, there are some facts in connection with Utah coal which are public information and which I can mention to you, and which I have discovered in my investigation.

One is that there is only a small amount of moisture in the coal, which has to be driven off before carbonizing.

Two, there are three or four times as much tar in the Utah coal as there is in the North Dakota lignite.

Three, the coal is well adapted to the Lurgi process of treating.

Four, there is a very definite demand in the market for smokeless fuel in Salt Lake City and some other points in the State.

Now, this plant in North Dakota was redesigned and rebuilt and expanded with the money that was advanced by the R. F. C., and I supervised the rebuilding of the plant, and then I supervised the operations of it for 2 years after it was completed.

Senator O'MAHONEY. When was that done? I mean, when was that loan made?

Mr. WHEELER. The loan was made in 1936, and the plant went into full operation in 1937, and I supervised the operation until 1939.

Senator O'MAHONEY. That loan was, therefore, altogether independent of the war?

Mr. WHEELER. Oh, yes.

Senator O'MAHONEY. And it was based upon the showing to the R. F. C. that the process could be profitably operated?

Mr. WHEELER. That the project was a commercial project.

Senator MURDOCK. And it is operating successfully now and repaying the loan?

Mr. WHEELER. It has been operating continuously since 1937, and the last information I had was that they were paying off a substantial amount each month on their indebtedness.

Senator MURDOCK. There can be little doubt then about the feasibility of the commercial plant out in the State of Utah with a much better grade of coal?

Mr. WHEELER. Well, I haven't written my report yet, Senator.

Senator MURDOCK. I am trying to anticipate it.

Mr. WHEELER. I wouldn't like to anticipate it, but those factors that I mentioned are favorable factors, I will say that.

Senator MURDOCK. Are you familiar at all, Mr. Wheeler, with the work that has been done on the Utah coal by the Coalogs people?

Mr. WHEELER. Well, I have heard of it. I cannot say that I am familiar with it, except that I have read about it. I have no personal knowledge of it from actual contact with it.

Senator MURDOCK. Do you know either Mr. Carpenter or Mr. Storrs?

Mr. WHEELER. I met Professor Carter out there.

Senator MURDOCK. Carter, that is right.

Mr. WHEELER. Yes; I met Professor Carter. I never met Mr. Storrs.

The feature that I would like to bring particularly to your attention in connection with this North Dakota plant and that type of plant is the fact that you get there low-temperature tars which is the basis of their operations in Germany, at least, the basis of a large part of their operations.

Consequently, if you are going in to the investigation of synthetic oil and gasoline, you, it seems to me, have a plant here that is producing now the material you need for some of your experimental work at least. You represent to the committee that in this plant there is now in operation a superior process for making the low-temperature tars from which by the process of hydrogenation the gasoline and oil can be manufactured?

Mr. WHEELER. Yes, sir. I want to say that I personally do not know a great deal about the process of hydrogenation, and I don't think there is anybody in this country that has had very much personal experience with it. All I know is what I have read about it. But I do know about this plant because I engineered it and operated it.

Senator O'MAHONEY. Are there any other questions?

(No response.)

Senator O'MAHONEY. Had you completed your statement, Mr. Wheeler?

Mr. WHEELER. Yes, sir; unless you have some questions.

Senator O'MAHONEY. Are there any questions?

Congressman FENTON. One question, if I may, Senator.

Senator O'MAHONEY. Yes, Congressman Fenton.

Congressman FENTON. Has your company done any experimental work on coal other than bituminous and soft coal?

In other words, have you done anything with anthracite?

Mr. WHEELER. No, sir; the briquettes that come out of this process are very similar to anthracite in burning properties, but, so far as my work goes, I have not experimented with anthracite in connection with a process of this type. Is that what you mean?

Congressman FENTON. That is correct.

Mr. WHEELER. No; I have not.

Congressman FENTON. Well, what did you say was the price per ton of briquettes?

Mr. WHEELER. Price per ton?

Congressman FENTON. Yes.

Mr. WHEELER. I didn't say.

Congressman FENTON. What is the cost of briquettes?

Mr. WHEELER. They sold the briquettes at \$7.50 a ton f. o. b. the cars at the plant.

Congressman FENTON. That is all.

Senator O'MAHONEY. Are there any other questions?

Senator Murdock?

Senator MURDOCK. No questions.

Congressman RANDOLPH. I would like to ask the witness: How many men are employed in this plant on which the loan was made?

Mr. WHEELER. In the mine and plant, about 125 men.

Congressman RANDOLPH. Has that been a rather sustained employment during the year?

Mr. WHEELER. Yes; so far as I know.

Senator GURNEY. In the briquetting plant, Mr. Wheeler, are there additional men?

Mr. WHEELER. No. It is about half in the mine and about half on the surface.

Senator O'MAHONEY. That briquetting plant is not in the custody of the Alien Property Custodian?

Mr. O'MAHONY. No.

Senator O'MAHONEY. The only company in the custody of the Alien Property Custodian is the American Lurgi Corporation?

Mr. O'MAHONY. That is right.

Senator O'MAHONEY. Which is a corporation which sells services?

Mr. O'MAHONY. That is right.

Senator O'MAHONEY. And it is not the corporation that produces these commodities which have been discussed here?

Mr. O'MAHONY. That is right.

Mr. WHEELER. The American Lurgi Corporation doesn't have anything to do with this plant in North Dakota except that they use their process and they were the original engineers of the plant.

Senator MURDOCK. The plant in North Dakota paid to the American Lurgi Corporation \$30,000, as I understand it, for the use of its processes?

Mr. WHEELER. That is right.

Senator MURDOCK. Now, I would like to ask Mr. O'Mahony this question:

In taking over the American Lurgi plant, you took over all its assets, did you not?

Mr. O'MAHONY. Yes, sir.

Senator MURDOCK. And the patents, of course were taken over by you?

Mr. O'MAHONY. That is right.

Senator MURDOCK. And are now in the custody of the Alien Property Custodian?

Mr. O'MAHONY. That is right.

Senator MURDOCK. Now, if the plant in North Dakota, which is operated there, had to pay to the American Lurgi Corporation \$30,000 for the use of its process, what is the present position of the Bureau of Mines, or any person or corporation that might want to use that process now in your custody, would they have to pay \$30,000 to do it?

Mr. O'MAHONY. Everything will be placed at the service of the Bureau of Mines, or the service of this committee to further any plan that might evolve in the solution of this problem and go to it with all royalties and fees waived. That is the policy of the custodian.

Senator MURDOCK. That is, the Bureau of Mines will have to pay nothing for the use of these patents that are now in your custody?

Mr. O'MAHONY. That is right.

Senator O'MAHONEY. Thank you very much.

Dr. Fieldner?

**STATEMENT OF A. C. FIELDNER, CHIEF, FUELS AND EXPLOSIVES
SERVICE, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR**

Senator MURDOCK. Dr. Fieldner, will you state your name, and your position, and the agency you represent to the reporter, please?

Dr. FIELDNER. Arno C. Fieldner, Chief, Fuels and Explosives Service, Bureau of Mines, United States Department of the Interior.

I have been with the Bureau of Mines for many years and my experience and special field of work has been with fuels and primarily with coal and its products. I have a rather lengthy statement which I will not read but will touch on certain high lights which have not been stressed by others in these hearings.

Senator MURDOCK. But your total statement will be submitted for the record.

Dr. FIELDNER. I submit the total statement for the record; yes, sir.

Senator MURDOCK. And the statement is made in connection with S. 1243?

Dr. FIELDNER. Yes, sir.

Senator MURDOCK. You may go ahead, Dr. Fieldner.

Dr. FIELDNER. The Bureau of Mines became interested in the production of liquid fuels from coal and shale soon after the First World War. The gasless Sundays of 1918 indicated the growing importance of liquid motor fuel, and by 1919 practically all ships of the Navy were driven by fuel oil. European powers recognized the increasing importance of fuel oil and gasoline in warfare, and early in the twenties nations that had coal but no domestic sources of petroleum started active developmental research on producing oil from coal.

At that time the United States had no immediate interest in making oil from coal because discoveries of new petroleum fields within the United States were increasing more rapidly than the growing needs for motor fuel. Such interest as there was expressed itself in attempts to develop processes for low-temperature carbonization of coal, whereby a smokeless, easily ignitable solid fuel was obtained as a principal product and 15 to 30 gallons of oillike tar was obtained as a byproduct, per ton of coal carbonized. It was demonstrated that this tar oil could be refined by usual cracking methods of the petroleum industry to yield 20 to 30 percent of motor fuel; in addition, tar acids (now a useful raw material in the growing plastics industry) could be extracted from the crude tar before cracking it to motor fuel.

I mention this because of the reference to the carbonization of lignite and recovering the tar from lignite for processing in hydrogenation plants to make gasoline. This same low-temperature carbonization process can be applied to coals which yield much more tar than lignite.

Lignite will yield 8 or 9 gallons of tar per ton of fuel carbonized whereas bituminous coal will yield from 20 to 30, and in some cases as high as 35 gallons of tar per ton of coal carbonized.

Senator MURDOCK. Then is the residue suitable for fuel?

Dr. FIELDNER. That residue is suitable for smokeless fuel; yes.

In 1924 the Bureau of Mines sent me to Europe to make a study of these low temperature carbonization processes and also of the hydrogenation process. I visited the Bergius plant at Mannheim, Germany, in 1924 and saw it operate.

It was then in a preliminary stage and a long ways from a commercial process, but nevertheless, at that time in 1924, they had what we would call a full-scale, single-unit plant such as we propose in this bill, and they also had a number of low-temperature carbonization plants, which were all in an experimental stage, none of them had, at that time, reached commercial development.

In England there was one type of low-temperature carbonization which had reached a commercial stage. Four plants had an aggregate carbonizing capacity of 500,000 tons of coal a year in 1937. This quantity of coal would yield 250,000 barrels of crude tar oil and light oil which can be cracked and refined by the usual methods, or better, can be hydrogenated either alone or mixed with powdered coal to produce high-octane gasoline.

Congressman RANDOLPH. At that point may I interrupt? When you speak of high-octane gasoline, you are referring to 100-octane?

Dr. FIELDNER. Well, approaching that.

Congressman RANDOLPH. The reason I asked that question is—

Dr. FIELDNER (interposing). After it is leaded.

Congressman RANDOLPH. I would like for you to tell the committee at the Pittsburgh plant what octane you are now generally producing by the hydrogenation process?

Dr. FIELDNER. About 75 without leading it.

Congressman RANDOLPH. 68 I think was what they started at that plant with and then have worked it up over the years.

Dr. FIELDNER. Well, it varies somewhat. Dr. Storch, will you check me on that? At the present time it is about 75?

Dr. STORCH. Yes.

Congressman RANDOLPH. And you have reason to believe that in Germany they have perhaps run it up to 90 or 95?

Dr. FIELDNER. That is right; after leading it.

Congressman RANDOLPH. Yes.

Dr. FIELDNER. Probably 92.

Dr. STORCH. That is right, after leading it.

Congressman RANDOLPH. Until we lead it, is there any difference in the United States, in our experimental program, from that which has been developed in Germany?

Dr. FIELDNER. No, sir.

Congressman RANDOLPH. It is just a matter of leading?

Dr. FIELDNER. Yes, sir.

Congressman RANDOLPH. To get the high octane quality?

Dr. FIELDNER. Yes, sir. Low-temperature carbonization yields for each ton of coal some 8 to 20 gallons of a tarry oil, which is a good feed for a coal-hydrogenation plant, either by itself, or mixed with powdered coal; but low-temperature carbonization alone is not a feasible process to take care of the very large amount of liquid fuel that we will need because of the necessity of disposing two-thirds of a ton of coke as a byproduct of gasoline production.

In other words, this oil we hydrogenate is a byproduct. The coke is the main product.

For instance, these briquets, that is, the main product by that process.

Now, if we had a number of these coal-carbonization plants and collected the tar from them and sent it to a central hydrogenation plant, then we would be doing what they are doing in Germany and what they did at Billingham, England. The Billingham plant was designed to use 100,000 tons of coal a year, and 50,000 tons of tar. Both low-temperature tar and high-temperature tar was used. Most of the tar that was mixed with the coal came from regular high-temperature coking and gas-manufacturing plants, because, even in England, low-temperature carbonization is a relatively small industry compared to the gas and coking industry.

All of this discussion of making gasoline from the tar obtained from the carbonization of coal or lignite, relatés to a byproduct, not to a main product.

It will be helpful in the broad picture as it develops, but it will not supply the very large amounts of liquid fuel that will be needed. We have got to go to hydrogenation of the coal, or its complete gasification by the Fischer-Tropsch process and conversion to gasoline, because those are the two processes which give complete conversion of your coal to liquid fuel.

Senator MURDOCK. When you do the latter, is there any residue, smokeless fuel, left at all?

Dr. FIELDNER. Not from either. In the Bergius direct hydrogenation process, there is no residue except the ash-forming material, and a small amount of carbon that does not liquefy.

Similarly, in the Fischer-Tropsch process, it is all converted to gas and there is no solid fuel residue.

In table I of my statement, I have stated that the total of all ranks of coal in our reserve as of January 1, 1942, is about 3.2 trillion tons.

If we divide that by the annual production in 1941 we have a total life of all coal reserves of 3,000 years.

Our proved reserve of 20,000,000,000 barrels of petroleum should last 14 years at the 1942 production rate.

Our oil shale of 92,000,000,000 barrels of potential oil used at the rate of 1.4 billion barrels per year should last 65 years.

Natural gas, assuming a reserve of 85 trillion, should last 30 years at the 1941 rate of consumption.

But if we took all of that natural gas to supply the 1.4 billion barrels of crude oil, it would last only 4 to 5 years, and that checks with what others have estimated.

Senator O'MAHONEY. The question naturally arises with respect to all of these as to what is the most efficient use of each commodity.

Dr. FIELDNER. Yes, sir; that is a very important question. Natural gas is a primary fuel. It is perhaps the most flexible fuel we have. It is supplied for heating homes. It is used in heat-treating furnaces in industries where temperatures have to be closely controlled. It would seem that those uses where we can get the benefit of all the B. t. u.'s of natural gas would be preferable to converting it to gasoline because we sacrifice about half of the B. t. u.'s of the natural gas when we change it from a gaseous fuel to a liquid fuel.

Senator O'MAHONEY. Where we have a so much larger amount of raw material in reserve in the case of coal, it would be preferable to use that as the raw material rather than to use the natural gas?

Dr. FIELDNER. Yes, sir.

Senator O'MAHONEY. But the evidence before the committee would tend to indicate that natural gas could be used as a raw material at a much smaller investment cost than coal.

Dr. FIELDNER. That is correct, Senator, considerably less, and it should be used where there is no other use for it.

Senator O'MAHONEY. Now, then, with respect to oil shale, is there any other commodity to which the commodity can be put?

Dr. FIELDNER. We haven't discovered any yet, and the oil-shale proponent has a very good argument there.

Senator O'MAHONEY. So that with respect to this particular commodity, the most efficient use of it is to make oil and gasoline from it?

Dr. FIELDNER. Yes, sir.

Senator O'MAHONEY. According to our present information.

Dr. FIELDNER. Yes, sir.

I do not wish to leave the impression that natural gas should not be used for making gasoline. There are places where natural gas actually is going to waste, and it would be much more efficient to convert it to gasoline; and I think that the industry itself, the petroleum companies, will develop those processes and have them going for natural gas without any assistance on the part of the Government. I think the Government's efforts should be devoted to the oil shale and the coal and lignite. Those are the long-run reserves. The natural gas reserve is a relatively short life.

Senator MURDOCK. In the conversion of the natural gas to gasoline, there is a very material loss?

Dr. FIELDNER. There is a loss of heat units, and there also is a loss of heat units in converting coal to liquid fuel. We sacrifice fully half of the B. t. u. in the coal when we convert it to gasoline.

In other words, the B. t. u. in the gasoline obtained from a ton of coal are less than half of the B. t. u. in the coal that we start with.

Senator MURDOCK. Where you merely produce, however, the tar and still retain the residue as a smokeless fuel, is there a very material loss there?

Dr. FIELDNER. The loss is less in the conversion of tar, the byproduct, to gasoline.

Senator O'MAHONEY. I wonder, Dr. Fieldner, if I could ask one or two questions before you proceed any further?

Dr. FIELDNER. Yes, sir.

Senator O'MAHONEY. What processes are used at the Bureau of Mines test plant at Pittsburgh now for the manufacture of synthetic fuel?

Dr. FIELDNER. For the last 5 years we have been operating a small direct coal hydrogenation plant, the modified Bergius process where the coal is treated with hydrogen under high pressure, very high pressure, at a temperature of about 750° F.

Senator O'MAHONEY. Now, how does that differ from the process that was described by Dr. Mueller here a few moments ago for the manufacture of tar by a low-temperature process?

Dr. FIELDNER. They are two different things. His process for the manufacture of coal tar is really a process for carbonizing lignite,

making a solid smokeless fuel from it which can be briquetted into lumps and sold as a domestic fuel. In that process he obtains a by-product amounting to tar, which may run from 7, 8, or 9 gallons per ton.

That tar could be sold to a coal-hydrogenation plant to mix with powdered coal that they feed into this plant for conversion into gasoline.

Senator O'MAHONEY. Let me understand it. Under the process used by the Bureau of Mines, powdered coal rather than liquid tar is the material?

Dr. FIELDNER. Powdered coal is our raw material.

The powdered coal is mixed with about an equal volume of heavy oil, and then that mixture—

Senator O'MAHONEY (interposing). What sort of oil?

Dr. FIELDNER. The oil is obtained from the process. We distill the oil from the process into a gasoline fraction, a light oil, a middle oil and a heavy oil. The heavy oil and some of the middle oil is mixed with the coal dust.

Senator O'MAHONEY. So that before you obtain the end product or begin to obtain the end product by a process of distillation, you obtain oil in the first instance?

Dr. FIELDNER. That is correct.

Senator O'MAHONEY. But that oil is not of sufficient quality to regard it as a finished process at that point?

Dr. FIELDNER. No, sir. As a matter of fact, when we started our plant in Pittsburgh we obtained some low-temperature tar from a commercially operated low-temperature carbonization plant in Pittsburgh, the Pittsburgh Coal Carbonization Co., to operate the process, until we had accumulated enough of the heavy oil to siphon it back and make our own oil. Once started, one can make enough heavy oil to mix with the coal dust.

Senator O'MAHONEY. Now, then, you heard the testimony of Dr. Mueller about the tar which is produced by the American Lurgi process is the material of which Germany is now making its gasoline and oil?

Dr. FIELDNER. Yes, sir.

Senator O'MAHONEY. Did you understand that?

Dr. FIELDNER. Yes; I understand that; and from the information that we have, it is correct—that Germany distills a large amount of brown coal and recovers the tar for use in the Bergius coal hydrogenation plants.

Senator O'MAHONEY. How does this process used in Germany and described by Dr. Mueller differ from the process that you are using at Pittsburgh?

Dr. FIELDNER. Dr. Mueller's process furnishes tar oils, which may be used as raw material, for the hydrogenation process.

Senator O'MAHONEY. I understand that.

Dr. FIELDNER. He doesn't hydrogenate the oil.

Senator O'MAHONEY. Yes; I understand that; but is that preliminary step by the German process better than the process which you are using, or does it differ in any respect?

Dr. FIELDNER. We could use that process in our plant just as easily as the other. That is, we could add tar from another source and make gasoline rather than make it from coal alone. The reason that

we work on the coal alone is because that is the part of the problem that requires the research.

It is comparatively simple to hydrogenate oils. The Standard Oil Co. has a plant in Louisiana for applying the hydrogenation process to heavy oils.

And the hydrogenation process of tar is a similar problem.

Senator O'MAHONEY. How about the process used in Great Britain. Does that differ in any respect from the process that you are using at Pittsburgh and the preliminary process used by the American Lurgi Corporation?

Dr. FIELDNER. I would like to refer that question to Dr. Storch.

Dr. STORCH. In Great Britain two-thirds of the raw material is coal and one-third is this low-temperature tar.

Senator O'MAHONEY. Is that the same sort of low-temperature tar which Dr. Mueller was speaking of?

Dr. STORCH. It is a low-temperature tar obtained by a different process, but it is a low-temperature tar. Now, I would like to clarify this situation somewhat by pointing out that in Germany the amount of gasoline that is obtained from low-temperature tar is only a relatively small fraction of the total synthetic gasoline. Most of the synthetic gasoline in Germany comes from coal.

In other words, if you try to make all your gasoline from tar you would have so many mountains of coke to dispose of that you just couldn't get rid of it, because coke is your main product in your low-temperature carbonization process. The low-temperature tar is just a byproduct which is brought into the synthetic-fuel scheme because it is very easily converted into gasoline.

Senator O'MAHONEY. Of course, this is a rather difficult thing for a lay person to absorb. I make that acknowledgment in explanation of the many questions that I have been asking. But it appears to me now, from what I have heard, that we have two processes for making gasoline by hydrogenation.

One is the so-called Bergius process and the other is the Fischer-Tropsch process. Is that correct?

Dr. FIELDNER. That is correct.

Senator O'MAHONEY. But there are apparently several different methods of making the material upon which the Bergius or the Fischer-Tropsch processes operate, is that right?

Dr. STORCH. That is right.

Senator O'MAHONEY. Now, the three which have been described here this afternoon are—

- (a) The process used by the American Lurgi Corporation;
- (b) The process used by the Bureau of Mines at Pittsburgh;
- (c) The process which you have inspected yourself and which is used in England.

Is that correct?

Dr. STORCH. That is correct.

Senator O'MAHONEY. How do these three differ one from the other and which is superior?

Dr. STORCH. The three have relatively little in common. You have got to pick them apart. There are essentially two different processes that we are talking about and not three.

Those two processes are: First, the Bergius high-pressure hydrogenation. That can be applied to coal, tar, petroleum. Then the second process that has come up for consideration is not a synthetic-fuel process at all. It is a process for making low-temperature coke, namely, with tar as a byproduct.

That tar can be used as a raw material for the Bergius process; but the process of making that low-temperature coke should not be confused with the Bergius process. It is essentially a different process designed to produce coke and not synthetic fuel.

Senator O'MAHONEY. My understanding was that the Bergius process would operate on the tar but the tar was made by a different method.

Dr. STORCH. That is correct. In other words, the Bergius process can operate on coal or tar or petroleum oil. It happens that in Great Britain their particular economy was such that they could operate best on two-thirds coal and one-third low-temperature tar.

In Germany the economy is such that they operate possibly on 80 percent brown coal and perhaps 20 percent tar, from the low-temperature coke plants. In America our economy is such that we don't use either coal or tar, but operate on petroleum alone, and use the Bergius process, at Baton Rouge, to produce aviation fuel.

Senator O'MAHONEY. But if you were operating as this bill contemplates, brown coal, would our plan approximate the Bergius or the German plan?

Dr. STORCH. It would approximate the German plan in that we would be mainly concerned with coal because we don't have a sufficiently large market for smokeless fuel to handle the enormous quantities that we would have to make to supply our gasoline demands entirely from this tar. We could only absorb about 10 percent of our total as low-temperature tar.

Senator O'MAHONEY. May I ask you whether the formula which is used in England is available to us?

Dr. STORCH. Yes. We have gotten very excellent cooperation from the British and they have given us plenty of time to inspect their plant and their data and they have discussed with us all of the intricacies of operation and research that they have gotten over the period from about 1932 to the present day.

Senator O'MAHONEY. Do you know what grade of gasoline in terms of octane value is made in Germany?

Dr. STORCH. No; I don't.

Senator O'MAHONEY. How about England?

Dr. STORCH. Well, the Billingham plant produces 72 to 75 octane gasoline as the bulk of the production, and that, when it is leaded, can be brought up to about 84. If you wish to make aviation gasoline, you take some of the byproducts from your coal hydrogenation plant and make a material known as iso octane and you blend that with the main gasoline product from the plant, and you get from that a first-rate aviation fuel, and that is a good portion of the fuel that is used by the bombers in Great Britain, it comes with such blending with gasoline from high-pressure hydrogenation.

Senator O'MAHONEY. Dr. Fieldner, what is the octane value of the gasoline made at Pittsburgh?

Dr. FIELDNER. About 75.

Senator O'MAHONEY. Thank you very much. I think I have got this matter fairly clear in my mind.

Dr. FIELDNER. Senator, it is very difficult to explain this, because there are so many different raw materials that can be used and these raw materials can be made by different methods. There are dozens of low-temperature carbonization processes. There is also the high-temperature carbonization process for making coke. And that can be linked with this process. The coke can be used for making water gas by the Fischer-Tropsch process, and the tar can be hydrogenated to gasoline.

We have simplified our work at Pittsburgh by assaying the different kinds of coal and determining their amenability to liquefaction. That chart in the center of the exhibit gives the yields of gasoline from coals in different parts of the country, ranging from our very best bituminous coals to the low rank sub-bituminous coals and lignite.

For example, certain coals from the Appalachian field yielded 130, 126 gallons, 134 and 105 gallons; Illinois field, 122, 112; from Utah, 136; from the State of Washington, 120; from Wyoming, 100 gallons.

Then there is the lignite from North Dakota, 65 and 63 gallons. These are the gallons of gasoline obtained when a ton of coal is liquefied by the Bergius process.

It does not include the coal used for making the hydrogen and the steam and the power. It takes an equal amount of coal to do that. So really those figures should be divided by two to get the net yield of gasoline per ton of coal used for all purposes in the process.

Senator MURDOCK. May I ask, can you identify the process that is being used in Pittsburgh as either the Fischer-Tropsch process or the Bergius process?

Dr. FIELDNER. This is all by the Bergius process. That process is the one that we have been working on for the last 4 or 5 years. It wasn't until this past year that we received an appropriation for beginning some studies on the Fischer-Tropsch process.

So far, our work has been devoted to the study of different catalytic materials.

We have no results to give you on the Fischer-Tropsch process from our own laboratory. A year from now we expect to have some results.

I would like to read the last paragraph of my statement.

Senate bill 1243 authorizes the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances. It includes laboratory and development work necessary to determine the best demonstration-plant designs and conditions of operation. The program should include demonstration plants for (a) the distillation of oil shale, (b) the direct hydrogenation of coal or lignite by some modification of the Bergius process, and (c) the indirect hydrogenation of coal or lignite by the Fischer process. The size of these plants should be the minimum that will give adequate technical information on methods of operation, commercial production costs, and the quality of the products obtained.

At the hearings of the Subcommittee on Gasoline and Chemical Products from Coal, of the Committee on Mines and Mining of the House of Representatives, held in June 1942, it was suggested that Bureau of Mines engineers should visit England and obtain first-hand information on the progress in this field in Great Britain.

Acting on this suggestion, the Bureau recently sent Dr. H. H. Storch, supervising chemist in direct charge of our synthetic fuel research at the Bureau's Pittsburgh experiment station, and Dr. W. C. Schroeder, chemical engineer and Assistant Chief of our Fuels and Explosive Service, to Great Britain where they visited the commercial coal hydrogenation plant of Imperial Chemical Industries, the British Fuel Research Station, and the Scottish oil shale plants. They were received very cordially and obtained valuable help, which will be useful in developing our demonstration-plant program. I will not go into the results of their visit, as they are present at these hearings and can speak for themselves. You will be interested in what they have to say, and I am sure that they will be glad to answer your questions insofar as they do not involve revealing information that must be kept in confidence with respect to the war program.

I will not go into the results of this visit as they will give their statements later.

Senator O'MAHONEY. Are there any questions?

(No response.)

Senator O'MAHONEY. Dr. Fieldner, we are very grateful to you and we will look forward with much pleasure to hearing Dr. Schroeder and Dr. Storch in Pittsburgh the day after tomorrow.

(Dr. Fieldner's statement is as follows:)

STATEMENT BY A. C. FIELDNER, CHIEF, FUELS AND EXPLOSIVES SERVICE, BUREAU OF MINES, UNITED STATES DEPARTMENT OF THE INTERIOR, BEFORE THE WAR MINERALS SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC LANDS AND SURVEYS, UNITED STATES SENATE, AUGUST 4, 1943

THE PRODUCTION OF LIQUID FUELS FROM COAL AND LIGNITE

The Bureau of Mines first became interested in the production of liquid fuels from coal and shale soon after the First World War. The gasless Sundays of 1918 indicated the growing importance of liquid motor fuel, and by 1919 practically all ships of the Navy were driven by fuel oil. European powers recognized the increasing importance of fuel oil and gasoline in warfare, and early in the twenties nations that had coal but no domestic sources of petroleum started active developmental research on producing oil from coal.

At that time the United States had no immediate interest in making oil from coal because discoveries of new petroleum fields within the United States were for the most part increasing more rapidly than the growing needs for motor fuel. Such interest as there was expressed itself in attempts to develop processes for low-temperature carbonization of coal, whereby a smokeless, easily ignitable solid fuel was obtained as a principal product and 15 to 30 gallons of oil-like tar was obtained as a byproduct per ton of coal carbonized. It was demonstrated that this tar oil could be refined by the usual "cracking" methods of the petroleum industry to yield 20 to 30 percent of motor fuel; in addition, tar acids (now a useful raw material in the growing plastics industry) could be extracted from the crude tar before "cracking" it to motor fuel.

Low-temperature carbonization

In 1924 the Bureau of Mines sent me to Great Britain and continental Europe to study new developments in coal research. As stated in my published report,¹ I found widespread interest in European coal-producing countries in low-temperature carbonization as one avenue for increasing domestic production of liquid fuels. I saw commercial-scale pilot or demonstration plants for a dozen different processes. Since that time a few of these processes have passed through suc-

¹ Fieldner, A. C., *Low-Temperature Carbonization of Coal*: Bureau of Mines, Technical Paper 396, 1926, 46 pp.

cessive stages of improvement and now are in commercial operation. The largest development is that of Low Temperature Carbonization, Ltd., in England, where four plants had an aggregate carbonizing capacity of 500,000 tons of coal a year in 1937. This quantity of coal would yield 250,000 bbl. of crude tar oil and light oil, which can be "cracked" and refined by the usual methods, or better, can be hydrogenated either alone or mixed with powdered coal to produce high-octane gasoline.

At the time of my visit to Germany in 1924, the only low-temperature carbonization process operating commercially was the "Rolle process," in which the bituminous brown coals of central Germany were being distilled principally for the oils and waxes they yielded. Since then other processes have been developed in Germany, and these brown-coal carbonization plants furnish tar oils which, with raw brown coal, comprise a large part of the raw material for the German coal-hydrogenation plants.

In the United States, low-temperature carbonization, likewise, received considerable attention from 1920 to 1930, not because of the liquid byproduct, but as a method of producing smokeless solid fuel from bituminous coal or lignite. The Bureau of Mines conducted laboratory studies² on bituminous coal and developed a simple commercial-scale carbonizer for lignite in North Dakota.³ University and industrial laboratories also worked on low-temperature carbonization, and at least a dozen processes were developed to full-size units on a pilot-plant scale.⁴ Partly because of technical defects but principally because of economic deficiencies, most of these processes never have been put into commercial operation. At present, two low-temperature carbonization processes are in commercial operation in the United States. These are the modified Wisner process of the Pittsburgh Coal Carbonization Co., near Pittsburgh, Pa., and the Lurgi process of the Lehigh Briquetting Co., at Dickinson, N. Dak. The former plant has a capacity of about 325 tons of bituminous coal a day and the latter about 500 tons of lignite a day.

The direct production of motor fuel from low-temperature tar as yet has not been developed commercially, either in this country or abroad. However, in both England and Germany low-temperature tar is being used as an important part of the feed to the coal-hydrogenation plants for the production of synthetic gasoline; and it is reasonable to expect that, as petroleum supplies diminish, the rising price of fuel oil and gasoline will furnish the additional financial return that is needed for the profitable operation of smokeless solid-fuel-processing plants, especially if several suitably located central coal-hydrogenation plants are installed to purchase and hydrogenate these tars to synthetic gasoline.

This relation of low-temperature carbonization to the hydrogenation of coal is mentioned because low-temperature carbonization is often cited as the process that is most immediately available for supplementing a declining supply of petroleum gasoline. Without hydrogenating the tar, the average yield of gasoline that might be made per ton of high-volatile A bituminous coal carbonized is approximately 10 gallons; with the hydrogenation of the tar, this yield would be about 20 gallons; and utilization of the same amount of coal in direct hydrogenation without carbonization would yield about 60 gallons of gasoline.

² Davis, J. D., and Berger, H. G., the Yield and Quality of the Gas, Oil, and Other By-products of the Constituents of the Freeport Coal Bed, Pennsylvania: Carnegie Institute of Technology and Bureau of Mines Cooperative Bulletin 1, 1922, 43 pp.

Davis, J. D., and Parry, V. F., the Low-Temperature Carbonization of Pennsylvania Coals—the Pittsburgh and Upper Kittanning: Carnegie Institute of Technology and Bureau of Mines Cooperative Bulletin 8, 1923, 56 pp.

Davis, J. D., and Irey, K. M., Study of Wax From Low-Temperature Tar: Carnegie Institute of Technology and Bureau of Mines Cooperative Bulletin 48, 1931, 8 pp.

Brown, R. L., Cooper, R. B., Branting, B. F., and Pollock, R. N., Composition of Light Oils and Tar from Low-Temperature Carbonization of Utah Coal: Carnegie Institute of Technology and Bureau of Mines Cooperative Bulletins 31, 35, and 41, 1926–29, 15, 14, and 13 pp.

Davis, J. D., and Galloway, A. E., Composition of Some Low-Temperature Tars Now Being Produced on a Semicommercial Scale: Processing American Gas Association, 1925, pp. 887–899.

Parr, S. W., and Layng, T. E., the Coking of Utah Coals: Bureau of Mines Report of Investigations 2278, 1921, 13 pp.

Hood, O. P., and Odell, W. W., Investigations of the Preparation and Use of Lignite, 1918–25: Bureau of Mines Bulletin 255, 1926, 204 pp.

⁴ For descriptions of many of these processes see footnote 1 of this statement, the proceedings of the three international conferences on bituminous coal held at the Carnegie Institute of Technology, Pittsburgh, in 1926, 1928, and 1931, and a report of the Utah Conservation and Research Foundation on the Low-Temperature Carbonization of Utah Coals, May 1939, 872 pp.

It is seen, therefore, that hydrogenation produces six times as much gasoline as low-temperature carbonization, and it does not depend on the marketing of smokeless solid fuel as the principal product.

The maximum possible development of low-temperature carbonization cannot satisfy the demand for gasoline and Diesel fuel when petroleum production falls materially below the present level of 1.4 billion barrels a year. To supply such a large requirement, it will be necessary to resort to processes and raw materials in which liquid fuel is the principal product rather than a byproduct.

Direct processes for production of liquid fuels from natural gas, oil shale, tar sands, coal, and lignite

Reserves of raw materials.—The estimated mineral fuel reserves of the United States, as of January 1, 1942, are given in table 1 and are graphed to scale in figure 1. In this figure each resource is expressed in equivalent tons of bituminous coal of 13,000 British thermal units per pound calorific value. The proved resources of only 3.2 billion equivalent tons of natural gas, 4.5 billion tons of petroleum, and 21,000,000,000 tons of shale oil are very small compared to a total of 2,559 billion equivalent tons of bituminous coal. Of course, more petroleum and natural gas will be discovered, but we do not know how much or how soon they will be found. The known petroleum reserve of about 20,000,000,000 barrels is of about the same order of magnitude on a heating-value basis as the known reserves of natural gas. The shale-oil reserve in the United States is 4 to 5 times the known petroleum reserve. It is estimated at 92,000,000,000 barrels of oil. The tar sands of Alberta, Canada, may constitute an even larger potential source of oil. Geological estimates of this reserve are uncertain, but some of them are as high as 140,000,000,000 barrels of crude oil. A low grade of crude oil can be obtained from oil shale by distillation processes similar to those used in the low-temperature carbonization of coal. The tar sands yield a naphthenic oil by treatment with hot water and subsequent distillation. The production of motor fuel from shale oil or tar-sand oil will require hydrogenation or other more expensive processing than is now used in making gasoline from petroleum, but this processing probably will be less costly than the hydrogenation of coal. A. J. Kraemer, senior refinery engineer of the Petroleum and Natural Gas Division of the Bureau of Mines, will discuss oil shale in his statement, and I will make no further reference to it herein.

Gasoline and other liquid fuels may be obtained from coal and lignite by direct and indirect hydrogenation. Both processes were invented and first put into commercial production in Germany.

Direct process.—The direct process, usually termed the coal-hydrogenation or the Bergius process, was patented by F. Bergius in 1914 and developed to a commercial stage by the inventor and the I. G. Farbenindustrie. Commercial production in Germany began in 1926 and steadily increased until in 1942 it is estimated to have been about 4,000,000 metric tons (32,000,000 barrels) of gasoline a year.

In 1935 Imperial Chemical Industries at Billingham, England, completed a similar direct coal-hydrogenation plant having a capacity of 150,000 long tons (3,500 barrels a day) of gasoline a year.

From a chemical point of view the coal-hydrogenation process consists of forcing hydrogen into the complex coal molecules and removing oxygen so that its chemical constitution is changed to that of petroleum, whereupon the coal substance liquefies and actually becomes petroleum.

This reaction is accomplished by mixing a small amount—usually less than one-half of 1 percent of the weight of the coal—of a catalytic material, such as a compound of tin, with approximately equal parts of finely powdered coal or lignite and heavy oil previously obtained from the process, and pumping this paste into a high-pressure steel vessel with hydrogen gas at pressures of 3,000 to 8,000 pounds per square inch. The temperature of the reacting mass is maintained at 800° to 900° F.

The oil product from the reaction vessel is separated from the solid residue of ash-forming material and unliquefiable carbonaceous matter and is distilled into light-, middle-, and heavy-oil fractions. The light oil is refined directly to gasoline. The middle oil is hydrogenated further by pumping it in the vapor phase with hydrogen at high pressure and temperature through a second high-pressure vessel containing a fixed catalyst, such as molybdenum or tungsten sulfide.

TABLE 1.—Estimated mineral-fuel reserves of the United States

Description	Original reserve	Reserve, Jan. 1, 1942	Exhaustion per cent	Production, 1941	Equivalent tons bituminous coal of 13,000 British thermal units per pound calorific value ¹		Recovery, percent	Life at 1941 rate of production years ²
					Reserve, Jan. 1, 1942	Production, 1941		
1	2	3	4	5	6	7	8	9
Anthracite								
billions of net tons...	³ 22	⁴ 15	32	⁵ 0.056	15	0.055	⁶ 65	177
Low-volatile bituminous coal								
billions of net tons...	³ 56	⁴ 53	5	⁵ 1.101	57	.109	⁶ 70	366
High-volatile bituminous coal ⁸								
billions of net tons...	³ 1,379	⁴ 1,353	1.9	⁵ 3.398	1,405	.413	⁶ 70	2,381
Subbituminous coal								
billions of net tons...	³ 819	⁴ 818	.1	⁵ 0.012	598	.009	70	-----
Lignite								
billions of net tons...	³ 940	⁴ 939	.1	¹⁰ .003	484	.002	70	-----
Total, all ranks of coal								
billions of net tons...	3,216	3,178	1.2	.570	2,559	.588	69	3,003
Petroleum, proved reserve								
billions of bbl...	¹¹ 45	¹² 20	56	¹³ 1.404	4.5	.324	¹⁴ 100	14
Oil in oil shale ¹⁵do	92	92	0	0	21.0	0	¹⁴ 100	¹⁶ 65
Natural gas, proved reserve								
trillions of cubic feet...	¹⁷ 135	¹⁸ 85	38	¹⁹ 2.770	3.2	.107	¹⁴ 100	30
Total, all fuels.....					2,588	1.019	69.3	1,760

¹ Heating values used in conversion: Anthracite, 12,700 British thermal units per pound; low-volatile bituminous coal, 14,000 British thermal units per pound; high-volatile bituminous coal, 13,500 British thermal units per pound; subbituminous coal, 9,500 British thermal units per pound; lignite, 6,700 British thermal units per pound; crude petroleum, 6,000,000 British thermal units per barrel; natural gas, 1,000 British thermal units per cubic foot.

² Years life is computed by the following formula:
$$\frac{\text{Column 6} \times \text{column 8}}{100 \times \text{column 7}}$$

³ Hendricks, T. A., Chapter I, Coal Reserves. Energy Resources and National Policy: Report of the Energy Resources Committee to the National Resources Committee, January 1939, U. S. Government Printing Office, Washington, D. C., pp. 281-286.

⁴ Reserves as of Jan. 1, 1942, were computed by deducting 153 percent of the total coal mined before this date to allow for the 34.7 percent of the coal in the ground that is not recovered in the prevailing mining practice.

⁵ Corgan, J. A., Ridgway, R. H., and Coleman, A. V., Pennsylvania Anthracite: Chapter from Minerals Yearbook, 1941. Bureau of Mines, 1942, p. 1.

⁶ Report of U. S. Coal Commission, pt. II, 1925, p. 655.

⁷ Includes some medium-volatile coal.

⁸ Total production of low-volatile bituminous coal is estimated as 90 percent of the production of bituminous coal in districts No. 1 and No. 7 of the Bituminous Coal Division. On this basis approximately 20 percent of the total production of bituminous coal of the United States is low-volatile coal and the remainder is high-volatile plus subbituminous coal. The production of subbituminous coal is estimated from detailed county production reports of Montana, Wyoming, and Colorado. The production statistics are taken from the chapter on Bituminous Coal and Lignite, Bureau of Mines Minerals Yearbook for 1941.

⁹ Report of U. S. Coal Commission, pt. III, 1925, p. 1857.

¹⁰ Bituminous and lignite coal tables, Bituminous Coal Division, Department of the Interior, January 1943, p. 100.

¹¹ Proved reserve on Jan. 1, 1942, plus production from 1850 to 1941, inclusive.

¹² Estimated by Committee on Petroleum Reserves of the American Petroleum Institute. Chapter on Crude Petroleum and Petroleum Products. Minerals Yearbook, 1941. Bureau of Mines, 1942, pp. 7, 11.

¹³ See footnote ⁸.

¹⁴ Reserves of petroleum, oil shale, and natural gas are based on oil and gas recoverable by present day methods.

¹⁵ Winchester, D. E., The Oil Possibilities of the Oil Shales of the United States; Report II, Federal Oil Conservation Board, January 1928, pp. 13-14.

¹⁶ At 1941 rate of petroleum production.

¹⁷ Proved reserve on Jan. 1, 1942, plus marketed production from 1906 to 1941, inclusive. Total marketed production up to Jan. 1, 1937, is given as 37.81 trillion cubic feet, by Ralph W. Richards, ch. 3, Natural Gas Reserves, Energy Resources and National Policy. Report of the National Resources Committee, January 1939, U. S. Government Printing Office, Washington, D. C., pp. 294-297. Marketed production from 1937 to 1941, inclusive, was 12,611 trillion cubic feet. F. S. Lott and G. R. Hopkins, Natural Gas, ch. from Minerals Yearbook, 1941, U. S. Bureau of Mines, 1942, p. 2. Marketed production up to Jan. 1, 1941, is 50.42 trillion cubic feet.

¹⁸ Davis, Ralph E., Natural Gas Supply of the United States: Interstate Oil Compact Quarterly Bulletin, vol. 1, October 1942, p. 24. Published and distributed by the Interstate Oil Compact Commission, 437 State Capitol Building, Oklahoma City, Okla. See also, Gas, vol. 18, No. 11, 1942, pp. 22-6; Oil and Gas Journal, vol. 41, No. 22, Oct. 8, 1942, p. 37.

¹⁹ Marketed production. Lott, F. S., and Hopkins, G. R. Chapter on Natural Gas, Minerals Yearbook, 1941, Bureau of Mines, 1942, p. 1.

The product obtained is gasoline of 70 to 75 octane rating. By addition of tetraethyl lead, the octane number can be increased to 80 or 85. At increased cost and with sacrifice of the yield obtained, it is possible to increase the octane number of the leaded gasoline further to somewhat above 90.

Four to five tons of high-volatile bituminous coal is required to produce one ton of gasoline (0.59 to 0.76 short ton of bituminous coal per barrel of gasoline). This figure includes the coal needed for power, steam, and hydrogen used in the process; 6.5 tons of subbituminous coal and 9.0 tons of lignite are required for the production of 1 ton of gasoline (0.90 ton of subbituminous coal and 1.25 tons of lignite, respectively, per barrel of gasoline).

These figures are based on the assumption that oils heavier than gasoline will be recycled through the process until all are hydrogenated to form light oils. The process can be operated so that a portion of the yield consists of heavier oils similar to kerosene and fuel oil; and the Bureau of Mines has developed a modification for the production of a heavy Bunker "C" oil by hydrogenation at lower pressures of about 1,000 pounds per square inch.

Indirect process.—In the indirect hydrogenation process, known as the Fischer-Tropsch process (invented by Franz Fischer and Hans Tropsch), coal, lignite, or natural gas is first converted with the aid of steam to water gas, a mixture of carbon monoxide and hydrogen. This mixture of gases, in proper proportion and after suitable purification, is then passed over a solid catalyst at relatively low pressures (1 to 10 atmospheres) and temperatures ranging from 360° to 410° F. The products obtained are a low-octane gasoline, an excellent Diesel oil, liquefiable gases, and paraffin wax. One ton of these primary products is obtained from 4 to 4.5 tons of coke, which in turn requires carbonization of 5 to 6 tons of bituminous coal or about 0.70 ton of coal per barrel of motor fuel.

In recent years the Fischer-Tropsch process has been developed rapidly in Germany. Four plants with a total yearly capacity of 330,000 tons of gasoline are believed to have been put into operation in 1938 to 1940, and five more plants probably have been completed in the last 2 years. It is believed that the present capacity by this process is about 1,000,000 metric tons of gasoline, Diesel oil, liquefiable gases, and wax per year (9,000,000 barrels).

The process can be installed in relatively small units, whereas the direct coal-hydrogenation process requires a much larger capacity plant for economical operation.

The motor fuel obtained in the Fischer-Tropsch process has a very low octane number (about 55) and must be reformed by cracking before it can be used as a motor fuel. Even the reformed fuel, after being leaded, does not come up to American standards for aviation gasoline; however, the Diesel fuel is of excellent quality.

Estimated costs of production

The estimated total cost of producing gasoline from coal under American pre-war conditions by either the direct or indirect hydrogenation process ranges from 12 to 25 cents per United States gallon. The spread is due principally to various rates of amortization and capacity of the plants and secondly to the cost of the coal. Assuming a plant of 150,000 metric tons (3,500 barrels) of gasoline per year capacity and amortization of the plant in 10 years, the Imperial Defense (Falmouth) and Labor committees reports of Great Britain, made in 1938, indicated a cost of 18 cents per United States gallon. Under present conditions, with construction costs about 35 percent higher than 1938, W. S. Farish, late president of the Standard Oil Co. of New Jersey, in a report submitted to the subcommittee on Gasoline from Coal of the Mines and Mining Committee of the House of Representatives, estimated the total cost of production in a plant producing 2,950 barrels of gasoline per day at 22.6 cents per United States gallon by the direct coal-hydrogenation process and 19.2 cents by the Fischer-Tropsch process. Farish calls attention to the small capacity of these plants and to the lowering of costs by increasing the plant capacity. For a 30,000-barrel-per-day plant he estimates the cost at about 16 cents per United States gallon.

Farish also mentioned the use of the high-pressure hydrogenation process for obtaining higher yields of gasoline from low-grade petroleum than can be obtained by other fully developed processes and to the use of the Fischer-Tropsch process for converting natural gas to gasoline. With natural gas at 5 cents per 1,000 cubic feet, Farish estimated the cost of gasoline production at 8.8 cents per United States gallon. Table 2 gives comparative costs and steel requirements, as stated in the Farish report.

In my opinion, the lower costs of large-capacity plants, such as those producing 30,000 barrels a day, should be used in comparing costs of producing gasoline from coal to those of producing it from petroleum, since the petroleum estimates probably apply to similar large-scale production.

The relatively low cost of gasoline production by the Fischer-Tropsch process, using natural gas at 5 cents per 1,000 cubic feet (process 3), indicates that for some regions of the United States this process will become competitive with the production of gasoline from petroleum (process 6) as soon as the price of crude oil reaches \$2 a barrel; and with further improvements in the Fischer-

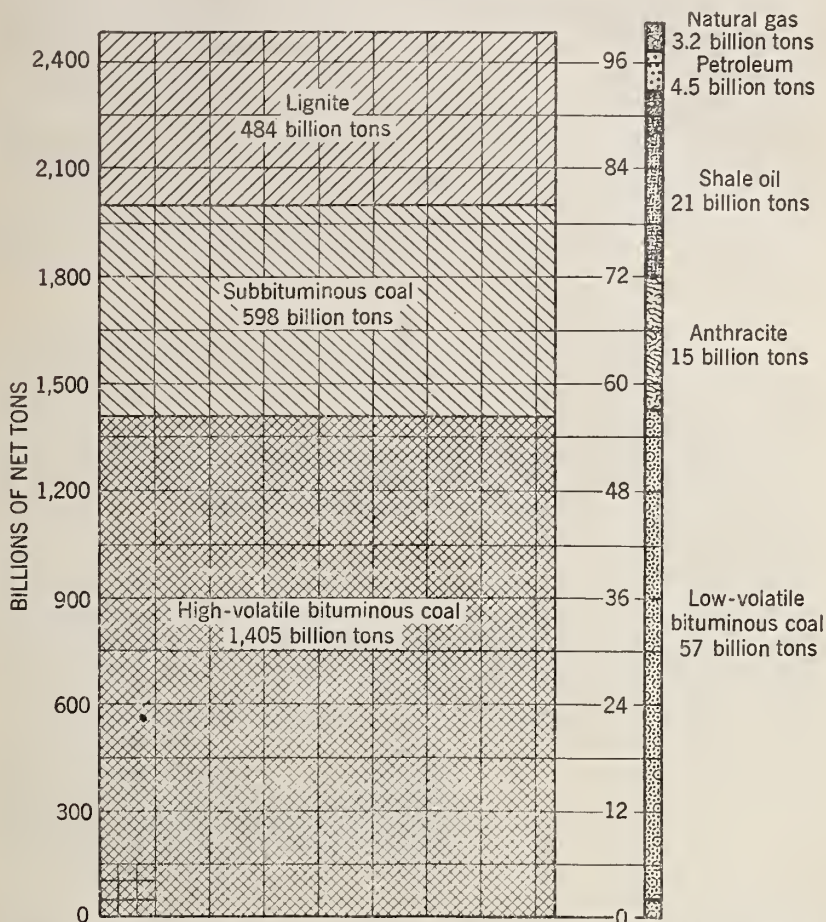


FIGURE 1.—Estimated mineral fuel resources of the United States as of January 1, 1942, expressed in equivalent tons of bituminous coal of 13,000 British thermal units per pound calorific value. Medium-volatile bituminous coal is distributed between high- and low-volatile coal (1 small square equals 2,000,000,000 tons).

Tropsch process resulting from an adequate program of research, it may become competitive at even lower prices of crude oil.

Steel requirements for direct coal hydrogenation

One of the important considerations in judging the feasibility of using either one or both hydrogenation processes for supplementing the national supply of motor fuels during the war period is the quantity of steel and other strategic materials and equipment required for building the plant.

As stated by Farish in his report, "Good information is not available on the direct steel requirements for coal hydrogenation." The figures in table 2 taken from his report, are the only published estimates that have come to the attention of the Bureau of Mines. It is perhaps somewhat presumptuous for the research men of the Bureau's staff to attempt a construction estimate of this nature; nevertheless, with the aid of data obtained from known steel requirements for parts of the process and similar operations Bureau engineers submit the rough estimates in tables 3 and 4.

It will be noted that the Bureau of Mines estimate is much lower than the Standard Oil estimate—8.8 tons per barrel of gasoline per day as compared to 14.1 tons. Possibly some important items have been omitted, or there may be a material difference in the basis of the respective estimates. But in either case the amount of steel required is very large, making it difficult to construct such plants during a period of critical shortage of steel. Multi-stage compressors, special electrical equipment, and special alloy-steel pressure vessels also are required, and these are very difficult to obtain.

The Fischer-Tropsch process involves much less special equipment but, according to Bureau estimates, requires more steel per barrel of gasoline than the direct hydrogenation process. The Bureau figure is 14.3 tons of steel, as compared with 8.9 tons estimated by the Standard Oil Co.

It must be emphasized that these estimates, made by the Bureau of Mines in the absence of any designs of commercial plants or of visits to such plants, must be regarded as very approximate, but they do indicate that the order of steel requirements is much larger than for petroleum refineries.

Direct hydrogenation of American coals and lignite

In 1936 the Bureau of Mines designed and constructed a laboratory-scale experimental coal-hydrogenation plant which has a capacity of about 100 pounds of coal, producing about 8 gallons of gasoline per 24 hours. The main objective of plant operations thus far has been to study the hydrogenating properties of coals from the more important coal beds in the United States. Fourteen coals have been assayed. The assay consists in determining the maximum quantity of an oil containing 20 percent of gasoline and 80 percent of oils boiling below 650° F., which can be produced in a single pass through one converter.

Table 5 contains the assay data on 14 coals ranging in rank from medium-volatile bituminous coal to lignite.

In the experimental plant, coals that contained more than about 7 percent of ash (in particular, coals such as those from the Mary Lee, Upper Freeport, and Fort Union lignite beds) were difficult to hydrogenate. It is also known from laboratory tests in small bombs that coals containing more than about 85 percent carbon are difficult to liquefy. It is therefore desirable to avoid high-ash and high-carbon coals in selecting a coal for liquefaction.

TABLE 2.—Comparison of methods for motor-gasoline production

	Approximate dollar investment ¹ per barrel motor gasoline per day	Approximate tons of steel per barrel of motor gasoline per day	Approximate direct cost of gasoline, including normal overhead but excluding depreciation	Approximate total cost of gasoline, including normal overhead and 10 percent depreciation
			<i>Cents</i>	<i>Cents</i>
1. High-pressure coal hydrogenation	² \$12,800	14.1	15.9	22.6
2. Fischer process, European design starting from coal	7,600	8.9	³ 14.7	⁴ 19.2
3. Fischer process, European design starting from natural gas ⁵	4,750	6.5	6.0	8.8
4. Modern high-pressure hydrogenation of petroleum ⁶	1,150	1.4	4.8	5.5
5. Modern oil refinery, crude at \$1.20 per barrel ⁷ ..	700	.7	5.1	5.3
6. Modern oil refinery, crude at \$2 per barrel ⁷ ..	700	.7	8.3	8.5

¹ 1942 costs for complete plant, including all utility supply and auxiliaries.

² \$7,500 for a 30,000-barrel-gasoline-per-day plant.

³ 12 cents for a 30,000-barrel-gasoline-per-day plant.

⁴ 15.5 cents for a 30,000-barrel-gasoline-per-day plant.

⁵ Natural gas at 5 cents per 1,000 cubic feet.

⁶ Crude at \$1.20 per barrel.

⁷ Crude price at the well. Additional footnotes by A. C. Fieldner.

TABLE 3.—*Approximate steel requirement for 4,500-pound working pressure direct coal hydrogenation plant of 3,500 barrels per day (365 days per year) gasoline capacity*

No.	Item	Weight, short tons
1	Plant to produce all steam required for power generation and process purposes.....	570
2	Generation of electric power for all purposes.....	800
3	Distribution and switching of power, all purposes.....	800
4	Process coal, receiving, storing, crushing, washing, drying, grinding, and pasting.....	370
5	Hydrogen manufacture.....	4,350
6	Hydrogen storage and other gas storage.....	4,000
7	Hydrogen compression.....	1,085
8	Hydrogen circulation at high pressure.....	170
9	Reaction vessels, including catch pots.....	1,380
10	Preheaters and heat exchangers, high-pressure type.....	1,300
11	Pumps for paste, middle oil, water, and scrubbing oil.....	1,715
12	Centrifuges.....	250
13	Pumps, motors, etc., not otherwise detailed.....	500
14	Tanks not covered previously but excluding any used to hold products after discharge from vapor-phase converters.....	500
15	Piping not previously covered but excluding any used to handle products after discharge from vapor-phase converters.....	1,000
16	Buildings, steel frame, machine tools, craneway, crane.....	4,000
	Total.....	22,790
	Add 25 percent for omissions.....	5,695
	Total steel.....	28,485
	Steel and iron per barrel (42 gal.) of refined gasoline, capacity but excluding any steel for handling or storing product after discharge from vapor-phase converter.....	8.1
17	By Standard Oil estimate, steel in modern petroleum-gasoline refinery, thermal cracking type.....	.7
	Est. total steel required per barrel (42 gal.) of refined gasoline per day.....	8.8

TABLE 4.—*Approximate steel requirement for a Fischer-Tropsch plant to produce from coke 2,140 barrels of gasoline per day (365 days per year)*

[This estimate contains no steel for coal carbonization]

No.	Item	Weight, short tons
1	Steam plant.....	300
2	Blue water-gas plant 15 sets at 5,000,000 cubic feet per day each.....	5,780
3	Conversion plant for making additional hydrogen and purifiers to produce finished synthesis gas.....	4,130
4	Equipment to produce primary oil from synthesis gas.....	16,200
5	Catalyst plant.....	1,000
6	Electrical equipment.....	200
7	Foundation, housing, and miscellaneous.....	2,000
8	Cracking plant and accessories.....	1,000
	Total tons of steel for Fischer-Tropsch plant.....	30,610

NOTE.—Therefore 30,610/2,140 or 14.3 tons of steel per barrel of gasoline per day.

TABLE 1.—*Coals assayed in Bureau of Mines experimental plant*

Origin and rank of coal					Analyses, percent				Yield of assay oil			Ultimate yield of gasoline ¹			Net yield of gasoline, gallon per ton of total coal used in process						
State	County	Coal bed	Mine	Rank	Moisture	Ash	Volatile matter	Carbon	Oxygen	Moisture and ash-free coal ²	Weight percent of—	Gallon per ton of—	Weight percent of—	Gallon per ton of—							
																As mined	Moisture and ash-free coal ²	Weight percent of—	Gallon per ton of—	Weight percent of—	Gallon per ton of—
Alabama	Jefferson	Mary Lee	Sayreton	Bituminous, high-volatile anthracite.	4.2	9.8	27.0	86.9	5.0	60	52	159	138	42	36	122	106	55			
		Upper Freeport	Indiana Colliery No. 21.	do	3.2	8.0	30.0	86.6	5.7	70	62	185	164	49	43	142	126	66			
West Virginia	Monongalia	Pittsburgh	Bruceston ⁴	do	1.6	6.3	37.0	84.2	6.8	70.5	64	187	170	49.5	45	148	130	70			
		Black Creek	Empire ⁵	do	2.7	2.9	36.0	84.3	7.5	70.5	66	187	175	49.5	46	148	134	68			
Pennsylvania	Walker	Lower Sunnyside	Columbia	Bituminous, high-volatile bituminous.	5.5	4.9	38.8	82.1	9.5	75	67	199	178	52.5	47	152	136	71			
		Upper Shaw	Eskas ⁶	do	3.7	6.8	41.8	81.0	10.5	73	67	193	178	51	47	148	136	71			
Alaska	Matanuska	Indiana No. 4	Saxton No. 1	Bituminous high-volatile coal.	13.6	7.3	34.2	80.9	9.5	70	55	186	146	49	38.5	143	112	58			
		Illinois No. 6	Orient No. 2	do	7.8	6.5	33.7	80.6	10.0	70.5	60	187	159	49.5	42	143.5	122	63			
Illinois	Franklin	Strain-Upper McKay	Black Diamond	do	9.6	3.7	40.1	78.6	12.5	68.5	59	182	156	48	41	139	120	62			
		Weld	Puritan	Subbituminous, bituminous.	24.1	4.1	29.1	76.6	16.4	63	45	167	119	44	31.5	128	91	47			
Colorado	Rosebud	Rosebud	Colstrip	do	25.1	7.6	28.5	76.7	16.2	60	40	159	106	42	28	122	81	42			
		Monarch	Monarch No. 45	do	23.2	3.9	31.2	75.6	16.9	88.5	49	182	130	43	34	139	100	33			
Montana	Sheridan	Fort Union	Benlah ⁴	Lignite	34.9	8.0	26.0	73.0	19.4	54.5	31	144	82	38	22	110	63	33			
		Mercer	Valva ⁴	do	39.5	4.5	26.0	72.0	21.4	52	32	138	85	36	22.5	106	65	34			

¹ Calculation based on assumption by 70 percent by weight, by assay oil converted to gasoline.² Assay oil assumed to have 26.5 gallons in 1 ton (2,000 pounds) and gasoline, 200 gallons.³ Calculation based on moisture and ash-free coal.⁴ Name of town.⁵ Figures are for "coal as mined and washed" for columns 12, 14, 16, and 18 for Utah and Alaska coals.

Low-ash sub-bituminous coals and lignite, which comprise 50 percent of the national coal reserves, were easy to liquefy, although the yields were only half that of high-rank bituminous coal. However, this lower yield may be compensated by low-cost strip mining.

Coal hydrogenation also provides an important source of organic chemicals of commercial value, such as tar acids (phenol, cresols, and xylenols) for plastics and benzol, toluol, and xylol for explosives manufacture and solvents. The yields of tar acids and tar bases are about 10 times those obtained in coal carbonization.

Careful appraisal of the present technical and economic status of processes for obtaining gasoline and Diesel fuel from coal leads to the conclusion that both the coal-hydrogenation and the water-gas synthesis processes are available for large-scale development under American conditions to supplement any future diminishing supply of petroleum fuels.

Further research required to put synthetic liquid fuel on a commercial basis

It must be emphasized that the industrial plants obtaining gasoline from coal in England, France, Japan, and Germany are not, in a strict sense, on a commercial basis. Subsidies in the form of tariffs or excise taxes on petroleum or gasoline from petroleum are required to make their operation commercially possible. None of these countries has any important home sources of petroleum, but all of them have extensive coal deposits. In wartime and during blockade, the production of motor fuels from coal is of the greatest importance to these countries. Until recently the large internal petroleum resources of the United States were adequate for all needs.

Large-scale production of liquid fuels from coal and oil shale in the United States requires research and development work on a commercial pilot-plant scale.

The Bureau of Mines has made a good start on this research program, but much more remains to be done before large commercial installations are justified. The small laboratory plant at the Central Experiment Station in Pittsburgh, Pa., should be enlarged to pilot-plant scale, so that the necessary data for designing commercial plants may be obtained. Also, there should be intensive research on the chemistry of the processes with a view to producing a product of higher octane value at lower cost. Commercial demonstration plants should be built as soon as possible.

About 15 years elapsed from the time that Dr. Bergius discovered the process of coal liquefaction until a large commercial plant was put into operation in Germany. Much research was necessary to solve the difficult problems attending the development of equipment for the process. It is certain that the end has not been reached and that more research and development will bring about further improvements and a lowering of cost. Liquid fuel is so important in war and peace that we cannot afford to lag in our work on this important problem.

The importance of synthetic gasoline and Diesel oil to remote United Nations, such as Alaska, South Africa, and Australia, and to our own Alaska is apparent when one considers the necessity of shipping these materials to such localities because of the absence of indigenous petroleum. The importance of synthetic fuel-oil processes to the United States proper is perhaps not so obvious, but those who are familiar with the rapid decline of the rate of discovery of oil pools know that the time is not far distant when synthetic fuels will be a vital part of our industrial set-up.

The Nation should protect itself from dilatoriness in this respect such as delayed the production of synthetic rubber. Such protection involves the erection and operation of full-scale, industrial-size units to solve the engineering problems involved in these processes.

The Bureau of Mines has in operation a small laboratory-scale (8 gallons of gasoline per day) pilot plant for direct hydrogenation of coal. It is ready to undertake the next step of installing and operating industrial-scale pilot plants. A full year of operation should furnish enough information for the proper construction of commercial plants, and continued operation probably would yield large returns in giving information on the improvement of yields and quality of products; this information could be applied in the commercial plants.

Less was known in this country on commercial-scale operation of the Fischer-Tropsch process of indirect hydrogenation than on the Bergius process. For this reason the Bureau of Mines requested and received an appropriation in the past fiscal year for the installation and operation of a small laboratory-scale pilot

plant (16 gallons of gasoline a day) analogous to that now operating on the Bergius process. A year's research on this scale and information received from abroad should provide the necessary information for designing and constructing an industrial-scale pilot plant.

Research and development on both hydrogenation processes should proceed in an orderly and progressive manner. However, emergency need for gasoline from coal or natural gas dictates parallel work on the design of commercial plants on the basis of existing information. Commercial plants have been built and operated in the United States for the hydrogenation of crude petroleum for the production of gasoline, and Imperial Chemical Industries of Great Britain should be able to send over engineers experienced in the operation of the Billingham plant in England to assist in the design of the coal-hydrogenation portion of an American plant. The data already obtained by the Bureau of Mines in its Pittsburgh experimental plant are sufficient to indicate the most suitable coals for the first commercial plant.

Less experience is available on the Fischer-Tropsch process, but several American companies have engineering information on much of the process. The exact nature of present catalysts and all the operating details of the latest German plans are not known. Further research and experimental work are needed to develop commercial plants.

Design and operation of demonstration plants

Senate bill 1243 authorizes the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances. It includes laboratory and development work necessary to determine the best demonstration-plant designs and conditions of operation. The program should include demonstration plants for (a) the distillation of oil shale, (b) the direct hydrogenation of coal or lignite by some modification of the Bergius process, and (c) the indirect hydrogenation of coal or lignite by the Fischer process. The size of these plants should be the minimum that will give adequate technical information on methods of operation, commercial production costs, and the quality of the products obtained.

At the hearings of the Subcommittee on Gasoline and Chemical Products from Coal, of the Committee on Mines and Mining of the House of Representatives, held in June 1942, it was suggested that Bureau of Mines engineers should visit England and obtain first-hand information on the progress in this field in Great Britain. Acting on this suggestion, the Bureau recently sent Dr. H. H. Storch, supervising chemist in direct charge of our synthetic fuel research at the Bureau's Pittsburgh experiment station, and Dr. W. C. Schroeder, chemical engineer and assistant chief of our Fuels and Explosive Service, to Great Britain where they visited the Commercial Coal Hydrogenation Plant of Imperial Chemical Industries, the British Fuel Research Station, and the Scottish oil shale plants. They were received very cordially and obtained valuable help, which will be useful in developing our demonstration-plant program. I will not go into the results of their visit, as they are present at these hearings and can speak for themselves. You will be interested in what they have to say, and I am sure that they will be glad to answer your questions insofar as they do not involve revealing information that must be kept in confidence with respect to the war program.

Senator O'MAHONEY. The committee now stands in recess.
(Whereupon, at 5:15 p. m., an adjournment was taken.)

SYNTHETIC LIQUID FUEL

FRIDAY, AUGUST 6, 1943

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC LANDS AND SURVEYS,
Pittsburgh, Pa.

The subcommittee met, pursuant to adjournment, at the Bureau of Mines Central Experiment Station, 4800 Forbes Street, at 10 a. m., Senator Joseph C. O'Mahoney (chairman) presiding.

Present: Senators O'Mahoney (chairman), Murdock, Gurney, Guffey, and Davis; Congressmen Randolph, Kelley, Furlong, and Scanlon; and W. H. McMains, clerk of the Senate Committee on Public Lands and Surveys.

Senator O'MAHONEY. This is a meeting of a Subcommittee on War Minerals of the Senate Committee on Public Lands and Surveys, which was appointed 2 years ago to study the development of strategic and critical materials on the public domain and to undertake investigation of the possibility of developing new industries for civilian life. It is participated in by a subcommittee of the Committee on Mines and Mining of the House of Representatives, under the chairmanship of the Honorable Jennings Randolph, Congressman from the State of West Virginia. The Members of the House committee who will be present today include Congressman Kelley, of Greensburg, Pa.; and Congressman Furlong, of Waynesburg, Pa.

The committee has issued invitations to the Governors of Pennsylvania, West Virginia, and Ohio to be present. The Governors, of course, are unusually busy these days, and I fear that they will not be here. Governor Martin is represented by Mr. Richard Maize; Governor Neely, of West Virginia, is represented by Mr. R. C. Tucker. Mr. Marcus Kerr, Chief of the Bureau of Mines of the State of Ohio, is here representing Governor Bricker.

The precise motive for the hearing has been to study a bill which is now pending in the Senate, S. 1243, authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other synthesis, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes. It will be observed that, from the title of the bill, its purposes are not confined solely to war. As the sponsor of the measure, I personally feel that this affords an opportunity for building a new industry in America. New industries will be greatly needed at the close of this war to provide the jobs which will be necessary for demobilized members of the armed forces and for those who will be displaced by the abandonment of war industries.

There will be an opportunity for the utilization in America in civilian industry and civilian life of a large amount of synthetic fuel.

The hearings which the committee has already held have resulted in the development of this fact: We are now using more oil every day than our new oil resources are capable of supplying. That means we are cutting down our reserves of petroleum. That there will be a broad development of aviation after the war I think seems obvious to everybody. As aviation is developed, it will require new sources of liquid fuel. The work of the committee, therefore, is laying the basis for the development of those sources of fuel.

About 2 years ago the Appropriations Committee, of which Senator Gurney, on my left, and the chairman are members, provided an appropriation to enable the Bureau of Mines to study, here in Pittsburgh at this station, the hydrogenation of coal. It is to learn how that plant is operated that the committee has come here today.

We shall first have a study from Dr. Sayers, the head of the Bureau of Mines, and then we shall have testimony by two experts of the Bureau who were sent abroad to England to study the hydrogenation process as it operates there.

The Senate committee today will be accompanied by the two Pennsylvania Senators, Senator Davis and Senator Guffey.

Senator Guffey has not yet arrived. I think it only proper to say that both of these Senators have been studying this same problem. Senator Guffey is chairman of the Senate Committee on Mines and Mining and a good deal of attention has already been devoted to the possibilities of utilizing the coal resources of this area for the manufacture of liquid fuels.

The first witness will be Dr. Sayers.

STATEMENT OF R. R. SAYERS, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Senator O'MAHONEY. State your name and position for the record, Dr. Sayers.

Dr. SAYERS. R. R. Sayers, Director, Bureau of Mines, United States Department of the Interior.

Senator O'MAHONEY. You may proceed, Doctor.

Dr. SAYERS. The United States has always had ample reserves of petroleum which could be obtained by drilling for oil and refining it for use by relatively inexpensive processes. So long as this condition existed and there was a full and sufficient supply of oil, little attention or concern had to be devoted to the more complex job of converting solids, such as coal, oil shale, or gases, to liquid fuels.

This heritage of petroleum has been developed by American ingenuity and initiative until today it stands only after food and shelter as one of the necessities of American life. Liquid fuels heat our homes, deliver our food, carry us to work, drive our airplanes, and allow us to overcome our enemies. Our economy is so heavily dependent on these fuels that it is unthinkable to do without them.

Since 1859, when the first well in this country was drilled at Titusville, Pa., approximately 26.5 billion barrels of oil have been removed from the ground. This huge quantity is more than our total known oil reserves at the present time. It may be a considerable fraction of the oil available to this country irrespective of the intensity of our efforts to discover oil.

However, while the amount of oil taken from the ground is known, at least approximately, we can only guess at what remains. On the other hand, if the most promising areas of the country have been prospected and drilled, if most of the lush fields have already been discovered, then the difficulties of finding more oil will increase.

Since 1938 this has been the case. The average estimated new oil discovered per field was slightly in excess of 15,000,000 barrels from 1934 to 1938, inclusive. For the years 1939 to 1941, inclusive, the estimated reserve per field has dropped to less than 3,000,000 barrels. At the same time, the total oil discovered in new pools has dropped to the point where it is being used at a much faster rate than it is being discovered.

These indications cannot be ignored by a nation as dependent on liquid fuels as the United States. They may mark a turning point in our national thinking. Instead of exporting oil and oil products, the country will need to conserve its resources to the utmost. Other countries, particularly South America, Persia, and Russia, may become relatively richer in petroleum.

Steps can be taken to relieve possible shortages. Oil can be imported, but this is not entirely satisfactory in either peace or war for our country. Prospecting and drilling can be increased in the United States. If, however, the trouble is due to a shortage of petroleum in the ground, this will not offer a permanent solution to the problem.

In contrast with uncertain prospects regarding petroleum reserves, with lack of assurance that the liquid fuel problems can be solved by prospecting and drilling, are the methods for producing such fuels from materials that are available in abundant quantity in this country. The known deposits of coal and lignite are sufficient to furnish all the fuel needed for combustion purposes and all the fuel for gasoline and oil, at our present rate of consumption, for at least 1,000 years. In the West there are deposits of oil shale, which are not being used in any way, that could furnish liquid fuel for over 65 years. Natural gas, which can be converted to liquid fuel, is available in smaller, but nevertheless substantial quantities.

Irrespective of the length of time, it is estimated that petroleum will meet the country's needs for liquid fuels—whether it is a few years or many years. Any reasonable national policy to insure the future of our country in peace or war demands that we develop processes for making liquid fuels from the raw materials known to be available in abundant supply to the point where large-sized plants can be built quickly when the need arises.

The present time is none too early to start on the program to develop these processes. The Germans needed from 1913 to 1932 to put the first commercial-scale plant in operation to convert coal to oil. With the knowledge that has been accumulated in this country and foreign countries, this period now can be reduced to a few years. At the same time, however, all of these processes are in relatively early stages of development and the chances are excellent for great changes and improvement which will materially reduce the cost of the product, the amount of material used in the construction of the plants, and simplify their engineering design. Therefore, in order that the first commercial plants in this country can be of the most

modern design, it is necessary to start our research and development work as soon as possible and to support it with funds which will permit ample investigation in all phases of the processes.

Nor can the United States expect or depend on commercial interests to carry out the necessary investigation of the processes materially in advance of the time at which they are actually needed. Gasoline from coal, lignite, or oil shale as far as can be seen at the present time, will cost more than from petroleum. No single company is in a good position to risk the money necessary in this development unless the time for the application of the processes is in sight. This is too late for starting this work. The country would suffer severely from the lack of liquid fuels long before it could build up the "know how" to do the job and to get the plants erected and in operation.

Bureau of Mines research to develop sources for liquid fuels, other than petroleum, dates back to 1926. At that time, studies were made of processes for extracting oil from oil shale. The results showed that feasible processes could be developed, but the discovery of large new pools of petroleum led many people to believe that petroleum reserves were inexhaustible. Inadequate financial support caused the Bureau to abandon the work in 1929. Advances since then in oil refining, cracking, and hydrogenation, development of new methods of extracting oil from shale, and mining shale have been extensive and important. Investigation should be resumed as quickly as possible to determine on a plant scale the best method of applying these advances to the preparation of gasoline and oil from shale and to the development of the cheapest and most efficient processes.

The Bureau's work on the hydrogenation of coal dates back to 1936. It has shown, on a laboratory scale, that many American and Alaskan coals are excellent raw materials for the hydrogenation processes and that they will yield high-quality fuel oil, motor gasoline, and aviation gasoline. The work has also developed low-pressure and relatively cheaper processes especially adapted to the production of fuel oil. All of this investigation has been on a small laboratory scale. It is now necessary to expand the whole investigation, to support it with adequate funds to permit the development of the best engineering design for the erection of commercial-sized plants.

The Bureau carried out a brief study of certain catalysts for the Fischer-Tropsch synthesis in 1929. This work was discontinued for want of funds until 1942 when testing was again resumed on a laboratory scale. This process uses as raw material, coal, lignite, natural gas, or in fact any fuel that can be converted into the gases carbon monoxide and hydrogen.

These gases are then combined in the presence of special catalysts to give gasoline, Diesel oil, and other oils and waxes.

The Germans rely most heavily on gasoline and oil from the Bergius and Fischer-Tropsch processes. It is probable that over one-half the oil that they are using to fight this war comes from their coal hydrogenation or synthesis plants. Most of the remainder comes from the oil wells in Rumania. Before the war started the Japanese had built Bergius and Fischer-Tropsch plants. It is probable that these have been expanded during the war. Both these countries have realized that substitute fuels might be used instead

of oil for some purposes, but in spite of this idea their major effort has been to construct plants to make gasoline and oil.

SUMMARY

The Bureau of Mines proposes to develop methods for making gasoline and oil by: (1) The hydrogenation of coal and lignite; (2) synthesis from carbon monoxide and hydrogen, and (3) extraction from oil shale. This work is to be carried into plants of such size that they will provide all the engineering design and cost data necessary for erection of large-scale commercial plants whenever they are needed. The program will be coupled with research and development work that will advance these processes well beyond their present state of development. This will allow the plants to be designed for the most efficient and modern operation.

From this program the people of the United States may expect the following:

(1) Complete designs for building plants to convert coal, lignite, oil shale, and natural gas to liquid fuel for meeting any petroleum shortage that develops.

(2) Means for making gasoline and oil from oil shale and lignite which in many sections of the country are now waste materials.

(3) Methods for making oil from raw materials which are known to be adequate to meet our demands for over 1,000 years.

(4) The means to be independent of all foreign countries so far as oil supply is concerned.

The effort required to carry out this program is relatively small as measured against the need of the country for assured supplies of liquid fuels.

Senator OMAHONEY. Do you have any questions, Senator Davis? I think I ought to make note of the fact that Senator Davis of Pennsylvania is the ranking Republican member of the Senate Committee on Mines and Mining.

Senator DAVIS. I have a note or two here.

Senator O'MAHONEY. Then you go right ahead, Senator.

Senator DAVIS. Doctor, can you tell us what our known deposits of coal are now?

Dr. SAYERS. About 3 trillion tons in this country.

Senator DAVIS. Since the opening of our first coal mine there has been mined about $1\frac{1}{4}$ percent of all our known deposits of coal. That includes waste, bad management, and everything else. That is, as I remember the figures. When I was Secretary of Labor, I used to go into this very thoroughly.

Dr. SAYERS. It is about $1\frac{1}{4}$ percent of the known deposits of coal; that is correct.

Senator DAVIS. At present we do not know where all our coal deposits are.

Dr. SAYERS. That is correct.

Senator DAVIS. There is much of it that we don't know anything about.

Dr. SAYERS. Yes, sir.

Senator DAVIS. I was very much interested in what you said about the oil reserves. How long do you suppose, using the oil as we have,

with our known reserves: how long do you suppose those reserves will last?

Dr. SAYERS. It has been estimated, Senator, if we were using it at our present rate, and we could get it out of the ground, which we cannot, at that constant rate, that it would last about 15 years.

Senator DAVIS. 15 years?

Dr. SAYERS. Yes, sir. However, because of the tremendous difficulties in getting it out, it will be probably 50 years before all this oil is obtained; also we would have to change our method of transportation and method of living, unless we have about the amount we are now getting.

Senator DAVIS. Of course, if we develop this particular process in the years to come, I think, with all of the coal we have in the ground, that those employed in developing the coal after it is outside, will be larger, probably be 10 times what is now employed in the coal industry. That is, it will develop that much more, in my opinion.

Dr. SAYERS. There has been an estimate made of about that figure, Senator.

Senator DAVIS. That is my guess about it, and I know that you are an expert along those particular lines, head of the Bureau of Mines, and a very efficient Director of the Bureau of Mines, I might add that.

Dr. SAYERS. I thank you, sir.

Senator DAVIS. I don't know what else I would have to say other than say it would be well if the committee itself would go up here to Clairton, that is the last place that I visited, to see a demonstration of the reduction of this to coke, and to these different oils that we have. I think it would be well worth the time of the committee, especially the gentlemen not familiar with this section of the country, my good friend from Wyoming, the chairman, and my good friend, Mr. Murdock, here from Utah, to go out and just see this; although, I think we have some of these, particularly these coke companies, out in Utah.

I have a little statement that I got up, Mr. Chairman, that I would like to have put in the record, if I may.

Senator O'MAHONEY. It will be inserted in the record at this point.

Senator DAVIS. That is all I have.

(The statement submitted by Senator Davis is as follows:)

STATEMENT FOR THE WAR MINERALS SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC LANDS AND SURVEYS, UNITED STATES SENATE

As a citizen of Pennsylvania I naturally am pleased to see this experimental development of oil from coal at the Pittsburgh Experiment Station of the Bureau of Mines. Pennsylvania has been a leader in providing fuel resources on which the great industries of the Nation are based. America's first oil well was completed by E. L. Drake near Titusville, Pa., in 1859. The first iron pipe line for natural gas—a 1-inch line 5½ miles long—was built in 1872 from the Newton well to Titusville, Pa. The first commercial attempt to obtain oil by sinking a shaft to the oil-bearing sands is now in progress near Franklin, Pa., and as you will witness today, the first coal hydrogenation experimental plant for producing gasoline from American coals is in actual operation. The first coal to be liquefied in this plant was taken from the Bureau of Mines experimental mine at Bruceton, Pa., near Pittsburgh from the great Pittsburgh bed of coal. I am told that this coal is quite similar to that which is being used in the British coal hydrogenation plant at Billingham. The Pittsburgh coal bed is the most important in the greatest coal region in the United States, and in fact the greatest in the world when both area and quality of coal are considered. This is the Appalachian coal region

which stretches from the northern line of Pennsylvania to central Alabama, a distance of about 800 miles. The northern half of this great coal basin has an average width of about 150 miles. While the Pittsburgh coal bed is absent because of erosion in some locations, it comprises a total area of about 15,000 square miles. The Appalachian region also contains many other coal beds of smaller extent, some of them of better quality in some respects and some of them of lower quality.

Pennsylvania is unique in having large deposits of the three most valuable ranks of coal. These are estimated at approximately 21,000,000,000 tons of anthracite, 9,500,000,000 tons of low-volatile bituminous coal, and 102,000,000,000 tons of high-volatile bituminous coal. Most of the bituminous coal is suitable for the manufacture of metallurgical coke. These resources make a total of 132,000,000,000 tons of all ranks of coal. West Virginia has 122,000,000,000 tons of high-volatile bituminous coal and 30,000,000,000 tons of low-volatile bituminous coal, making a total of 152,000,000,000 tons of coal, also of excellent quality for metallurgical, industrial, and domestic use. Ohio has a reserve of 94,000,000,000 tons of bituminous coal; Kentucky, 123,000,000,000 tons; Tennessee, 25,000,000,000 tons; and Alabama, 67,000,000,000 tons. The total reserves of these six States is 593,000,000,000 tons, or 600,000,000,000 in round numbers. This amount of coal is approximately one-fifth of the national reserves, and it is situated in close proximity to the heavy industries, which consume the most fuel, and other more densely populated sections of the United States.

In view of the approaching exhaustion of the petroleum and natural-gas resources of this region, it is, in my opinion, especially important that developmental work be undertaken in this region to produce liquid and gaseous fuels from coal.

Senator O'MAHONEY. Senator Murdock, of Utah, who has been a member of this committee since it was initiated, is present. Do you care to ask any questions, Senator?

Senator MURDOCK. One or two, Mr. Chairman.

Dr. Sayers, of the known deposits of coal in the world, what percentage is here in the United States?

Dr. SAYERS. I don't believe I can answer that, but I believe Dr. Fieldner can tell us what percentage it is.

Dr. FIELDNER. It is usually estimated that something over 50 percent, say 50 to 55 percent, is located here in the United States.

Senator MURDOCK. I remember at the hearings in Washington that was the figure given of the coal deposits in the world, about 50 percent of them are here in the United States.

Dr. SAYERS. Yes; that is correct.

Senator MURDOCK. I would like to ask you, Doctor, who is this Bergius, to whom is given credit for the Bergius process? Where does he come from?

Dr. SAYERS. He was a German. He began making studies along this line very early, and from 1913 to 1926 worked on the development of the process for doing this work. The first commercial plant for the Bergius process was built in 1926. Dr. Fieldner visited that plant just after that.

Senator MURDOCK. Now, where do we get the Fischer-Tropsch process?

Dr. SAYERS. Fischer developed that first in Germany.

Senator MURDOCK. Is he a German, too?

Dr. SAYERS. Yes.

Senator MURDOCK. And Tropsch is a German?

Dr. SAYERS. Yes.

Senator MURDOCK. So that the two processes, the Bergius process and the Fischer-Tropsch process, were invented or originated in Germany? Don't you think it is rather deplorable, Dr. Sayers, that this great country of ours, with 50 percent of the known coal reserves of the

world, is rather following their lead in the development and demonstration of processes for the hydrogenation of our coal?

Dr. SAYERS. Yes; I very definitely do. But I want to call to your attention that necessity is the mother of invention. Germany had to have oil if they were going to be self-sufficient. We do not want to get ourselves in that position and that is the reason, one of the big reasons, why we want now to go on with the development which apparently you are leading up to, Senator.

Senator MURDOCK. I am in agreement with you that necessity called for them to step out into the lead, but now that we begin to visualize the fact that our petroleum is not unlimited, it is high time, is it not, in your opinion, that we step into the lead?

Dr. SAYERS. It is, Senator.

Senator MURDOCK. In the processing of our coals and of our shale.

Dr. SAYERS. It is, Senator. We should develop these processes. We recommend that we do so promptly and continuously until a commercial stage is reached.

Senator MURDOCK. You consider, do you not, that the bill introduced by the distinguished Senator from Wyoming, our chairman here, is the right kind of legislation to bring about this development?

Dr. SAYERS. I do, Senator.

Senator MURDOCK. That is all.

Senator O'MAHONEY. What process is being followed here in the Bureau of Mines, in this station?

Dr. SAYERS. The hydrogenation, which is usually called the Bergius process. That is being followed and has been carried on since 1936.

However, the name was attached to it because he was the first to do this work. It is being modified and has been modified and we believe will be modified and improved until it will no longer be just the original Bergius process.

Senator O'MAHONEY. Have you effected any improvements to date?

Dr. SAYERS. We definitely think so, Senator.

For instance, I mentioned the making of heavy fuel oil at lower pressure and at lesser cost.

Senator O'MAHONEY. Your statement that 50 percent of the German war supply of liquid fuel comes from the hydrogenation process prompts the question as to the location of those plants in Germany. Do you know?

Dr. SAYERS. I do not know the location of most of them. Of course, I think that our military intelligence definitely knows the location and their capacity.

Senator O'MAHONEY. Dr. Fieldner visited one of these plants?

Dr. SAYERS. He visited the first one.

Senator O'MAHONEY. Where was that located, Dr. Fieldner?

Dr. FIELDNER. The plant I visited in 1924 was at Mannheim.

Senator O'MAHONEY. That is in the Ruhr?

Dr. FIELDNER. Near Frankfort, Germany.

Senator O'MAHONEY. Is that in the Ruhr Valley?

Dr. FIELDNER. That is up the Rhine some little distance from the Ruhr. That was an experimental plant. The first commercial plant in Germany was built at Leuna. That is near Dresden in central Germany, in the brown coal fields of Germany. That was built by the

I. G., the big dye trust in Germany that took over the Bergius process and developed it further.

Then the Germans built, in the last 10 years, a number of other Bergius plants, notably at Stettin on the Baltic Sea, and at Oppaur on the Rhine.

They also built about 10 Fischer-Tropsch plants that are pretty well scattered through all of the coal producing districts of Germany. The first one was built in the Ruhr near Essen.

That is the big bituminous coal district in Germany that corresponds to the Pittsburgh district in this country, where the high-grade coking coal is being mined for the steel industry.

The other Fischer-Tropsch plants are in various locations in the brown coal districts of central Germany, south of Berlin, in Saxony, and also in the Rhine district near Cologne.

Senator O'MAHONEY. It may be appropriate to remark that the recent bombing by American planes of the Rumanian oil fields and the bombing of the Ruhr Valley by the R. A. F. and the American planes, were both directed against, including others, the oil supply of the German military machine. The extent to which the bombing of these hydrogenation plants in Germany has been successful will have a tremendous effect upon the capacity of Germany to continue the war.

Senator, Gurney, have you any questions?

Senator GURNEY. One or two.

Doctor, from what information we have now, with coal from this area, how many gallons of gasoline can you reasonably expect to get from a ton of coal?

Dr. SAYERS. From this area I believe 136 was the highest. Isn't that correct?

Dr. FIELDNER. Yes. That was from Senator Murdock's state, from a Utah coal. But our coal from the experimental mine yielded 131 or 132 gallons wasn't it, Dr. Storch?

Dr. STORCH. Yes.

Dr. FIELDNER. Yes, 132; but we couldn't quite reach the yield of the Utah coal.

Senator MURDOCK. We don't expect you to reach that.

Senator GURNEY. Taking gasoline from coal, or motor fuel from coal, is more expensive than as it is now being refined in the petroleum fields?

Dr. SAYERS. Yes.

Senator GURNEY. Can we reasonably expect any by-products of value that would cut down the cost of that gasoline?

Dr. SAYERS. We probably can, but we also expect to lower the price; that is, the cost of the gasoline, by improvements in methods. Present cost estimates run from 10 or 12 up to 15 to 19 cents per gallon.

Senator GURNEY. Of course, the cost of gasoline made from petroleum depends on the price they pay for ground rent and labor cost and what not.

Dr. SAYERS. That is correct.

Senator GURNEY. Now, do you intend to reduce the cost of gasoline by getting more gallons out of each ton or by more efficient operation?

Dr. SAYERS. Certainly the latter would be the more important. For instance, take costs of mining. If we have more efficient methods of mining in some particular region it would make a great deal of difference. We believe that there have been very much more efficient methods of mining developed in the last 10 years that will reduce the cost of oil produced from oil shale very materially.

Senator GURNEY. That is a mechanical proposition.

Dr. SAYERS. Yes; but that comes into the cost of your final gasoline.

Senator GURNEY. Let me ask you: From a chemical standpoint, is there more than 132 gallons of oil or gasoline in a ton of coal?

Dr. SAYERS. Well, there probably is, but nevertheless we cannot guarantee that we are going to get all of it out. We haven't reached the limit of the technical possibilities as yet.

Senator GURNEY. I see. Then 132 gallons from this kind of coal in this area, per ton, is just a minimum at present?

Dr. SAYERS. I don't know whether it is the minimum, but it is what we can get now.

Senator GURNEY. There are possibilities of getting more gallons per ton, is that right?

Dr. SAYERS. I would think so. I can visualize methods whereby we might increase that to at least what we get from Utah coals.

Senator GURNEY. Of course, I wasn't talking about mining the coal in one State as compared with another.

Dr. SAYERS. No; as a matter of fact, that was facetious, and I would like to strike the remark from the record.

Senator GURNEY. Doctor, one more question. What byproducts of value might we obtain from this process?

Dr. SAYERS. I don't know whether you want to call them byproducts, but waxes, lubricating oil, toluene, xylene, tar acids and bases, as well as many other products can be secured.

Senator GURNEY. I take it then you can get all the byproducts from coal that you are now getting from crude oil?

Dr. SAYERS. I would expect every one of them. We make dyes, many medicines, and recently they have been talking about making vitamins. I haven't seen the one coming from coal yet, but it is entirely possible.

Senator GURNEY. And as I understand it, coal and crude petroleum comes from the original organic matter that has been stored in the ground millions of years so they are chemically about the same make-up; but what I am trying to get at is this: There are many additional byproducts that we could reasonably expect to come from the processing of coal; is there not?

Dr. SAYERS. Well, I had better ask Dr. Storch or Dr. Fieldner, but it is all entirely possible. I don't know whether you would call them byproducts or not.

That means it is something made without additional cost. After a while it may become the major product and you may manufacture for that particular purpose. We know we can make alcohols very readily from coal and we can make them from petroleum. Waxes, lubricating oils, and dyes can also be made.

Senator GURNEY. My questions were occasioned by the fact that in connection with using grain for the manufacture of motor fuel, we get into the manufacture of it and then find that the byproducts are so

valuable that it is reasonable to expect that in making alcohol in the future, you can give the alcohol away and still make money on processing the grain, so I was wondering how close you could come to that, or what hopes you had in the processing of coal.

That is all I have.

Senator O'MAHONEY. Congressman Randolph?

Congressman RANDOLPH. I should like to reiterate what I said on behalf of the House subcommittee at the beginning of the hearings in Washington. We are genuinely grateful for the opportunity of joining with the Senate in the discussion and investigation of this important matter. There are present today two members of the House Mines and Mining Committee, who have been especially assigned to the subject matter in the House.

I think that we are all delighted to have them here. They are Pennsylvanians, familiar with the work of the Bureau of Mines here, and also the coal deposits of this State and with the one-time oil deposits as well.

The Pittsburgh area, certainly this entire territory has been the fountain head, not only for coal but for oil.

Congressman Kelley, from Westmoreland County, member of the committee and member of the subcommittee is present, and I should like to defer my questions until after these two gentlemen, Mr. Kelley and Mr. Furlong, have asked what questions they desire.

Congressman Kelley, do you desire to ask the witness any questions?

Congressman KELLEY. One or two.

Doctor, I believe it was in 1926 that Dr. Bergius was in Pittsburgh, at the Carnegie Institute, at the international conference?

Dr. SAYERS. Yes.

Congressman KELLEY. And at that time he gave a very thorough explanation.

Dr. SAYERS. That is right.

Congressman KELLEY. And it developed during the hearings that the cost of extracting gasoline was prohibitive, especially as far as the United States was concerned, we had low-price gasoline and oil, and it was the general opinion, as I remember it, that the cost could be materially reduced, but whether it could be reduced to the point where it is profitable and advantageous for us to go into it was another thing.

Dr. SAYERS. That is right.

Congressman KELLEY. Now, what would be the cost do you suppose today in producing gasoline, extracting gasoline from coal, as compared with the gasoline that we extract from wells?

Dr. SAYERS. It is variously estimated, Congressman. Our estimates run from 15 to 19 cents. These are greatly influenced, however, by the cost of mining the coal. They may also be reduced with further development work on the processes.

Congressman KELLEY. I am intensely interested; the coal business is my business and I am naturally interested in finding new uses for coal, as well as aiding the Nation in its need for gasoline.

Now, isn't it true that certain grades of coal lend themselves to a better quality of gasoline and oil than other grades of coal?

Dr. SAYERS. That is true.

Congressman KELLEY. And if you use a grade of coal for the purpose of extracting gasoline, the cost of the gasoline extracted would be

lower in proportion to the amount of gasoline which you can get from a ton of coal?

Dr. SAYERS. That is true, to a certain extent. It would also depend on the method mining. If you had a deep mine for the high-grade coal, your cost of mining would be so much greater that it might be cheaper to use the lower grade of coal.

All of those points must be taken into consideration. That is part of the purpose of this bill, to determine each of those factors in order that they be available to industry and to the people of the country, to determine where they should build plants.

For instance, taking your company, you might decide to build a plant here rather than over yonder. You would want all the factors. You don't want only one factor. So, all of these factors should be developed. That is the purpose of the bill that was introduced here by the Senator.

Congressman KELLEY. Just as a matter of information, how many byproducts are obtained now or are available from coal?

I am thinking now that that tree.

Dr. SAYERS. Yes; I am thinking of the same thing. Dr. Fieldner may recall.

Do you recall, Doctor, how many different products you can get from coal?

Dr. FIELDNER. They run up into a very high figure.

Congressman KELLEY. Several hundred?

Dr. FIELDNER. Oh yes; approximately a thousand.

Dr. SAYERS. Yes.

Congressman KELLEY. That is all.

Congressman RANDOLPH. I would like now for Mr. Furlong, who is a member of the committee also, and is from Pennsylvania—I think perhaps they redistricted him a little and perhaps his coal section is shifted into another district—but he is intensely interested in this subject.

Congressman FURLONG. Dr. Sayers, we have a great fire department in the city of Pittsburgh; do we not?

Dr. SAYERS. Yes.

Congressman FURLONG. If a great conflagration breaks out here, does the fire department wait until the conflagration breaks out before ordering fire truck, fire apparatus of all kinds?

Dr. SAYERS. The answer is obvious. They certainly do not.

Congressman FURLONG. Then as of dire necessity, should we wait until we absolutely need these products before we build these plants?

Dr. SAYERS. We certainly should not.

Congressman FURLONG. Therefore, do you believe that this bill of Senator O'Mahoney should be enacted as soon as possible?

Dr. SAYERS. I certainly do.

Congressman FURLONG. So do I. Thank you, sir.

Senator O'MAHONEY. That is a very good statement.

Senator GUFFEY, I am aware, from our previous conferences, of your deep interest in this matter. Do you care to ask any questions at this time?

Senator GUFFEY. Dr. Sayers knows of my interest for many years. It dates a long time before Dr. Sayers was in the Department. Senator O'Mahoney and the members of the committee, I think are familiar with my activities in the natural gas and oil fields of

western Pennsylvania. I spent 20 years here, Mr. O'Mahoney, as manager of the largest natural gas company in the city. During that period I could see that there was going to be a depletion of our national resources and in 1927 and 1928, I sent a good engineer, who was out in Japan, I brought him home by way of Germany to become posted on the processes that Germany had developed. I was intensely interested in the subject.

Mr. George Westinghouse also had a vision. When the gas fields in Grapeville and Murrysburg started to become exhausted, he bought Brunots Island with the idea of making that the center for experiments in producing substitute fuel gas.

I hope this bill passes. We must get prepared for the future. I don't believe that we have the reserves that a lot of the oil men think we have. I mean, we can't get it out fast enough.

We have been producing oil in Pennsylvania for 75 years and we still have a lot left, but you can't take that reserve out in 5 years.

A lot of these reserves will be producing oil in 50 years, but that doesn't mean that we will have it available. When we get natural gasoline at the pumps at 25 to 30 cents, then we will have to use a substitute fuel. That is coming.

I want to say to the coal people, in whom I am very much interested, the coal people are coming into their own in the next 25 years in a substantial way. I don't think we have the oil to keep up with our present consumption. We will be converting a large quantity of oil as soon as the war is over. I hope we come to the day in the next 2 years when we will burn no oil for fuel oil, because fuel oil, and I think you will agree, Doctor, is a waste of a valuable product.

Dr. SAYERS. It certainly is.

Senator GUFFEY. Eighty percent can be redistilled and made into motor fuel.

Dr. SAYERS. That is correct.

Senator GUFFEY. Mr. O'Mahoney, I have discussed this with you before.

Senator O'MAHONEY. I am glad to have you make your statement here. We have known of your support of the measure. I was going to ask you, Senator, with respect to the secondary methods of recovering oil. You have had a great deal of experience with that in Pennsylvania, have you not?

Senator GUFFEY. Yes. The Bradford field in Pennsylvania and the Allegheny field in New York have been very, very successful. Still we are leaving, when they get through, a percentage of the oil in the ground.

Senator O'MAHONEY. But that is a small and more expensive process?

Senator GUFFEY. The water process is not so expensive, but when you come to mining they sink shafts on slopes and drain the oil out into the pit. Of course, you can't do that until the gas is gone. I think they are building a sinking shaft up near Franklin for that shale oil, and I think that Warren County was susceptible of doing a lot of production with that line.

I wouldn't advise trying it until we get the proof of the heavier oil. If it works in the heavier oil it will work in the lighter oil fields. I think we will get a third recovery, not a secondary, but a third.

Senator O'MAHONEY. It is clear now, from the present stage of development in the oil industry, that it is wise and desirable to bring in supplemental supplies of fuel, is it not?

Senator GUFFEY. I think we will do that in Pennsylvania for the third recovery and second recovery when the price gets worth while. You can't afford to do it at \$3 oil or at \$5 oil.

It may be that in a few years, when the war is over, the Pennsylvania oil is so valuable for lubricants that they will pay that for it.

Senator O'MAHONEY. Thank you very much, Senator.

Congressman RANDOLPH. Dr. Sayers, as Director of the Bureau of Mines, would you estimate for the committee the approximate coal reserve, given to us in a period of years, that you believe exists in the State of Pennsylvania?

Dr. SAYERS. You mean how much? I don't believe I have that figure.

Dr. Fieldner, do you know the reserves of coal in Pennsylvania in years?

Dr. FIELDNER. I think the Pennsylvania total coal reserves are about one hundred and forty to one hundred and fifty billion tons, including anthracite. I don't know what the consumption is for Pennsylvania. But it is good for many years.

Dr. SAYERS. Do you know, Mr. Maize?

Mr. MAIZE. Why, the recoverable reserve in Pennsylvania, in anthracite, is about 10,000,000,000 tons, and bituminous about 60,000,000,000 tons of recoverable coal.

That is allowing for losses; 15 percent loss in mining and refining.

Senator GUFFEY. Does that cover all the different formations, upper and lower?

Mr. MAIZE. That covers, Senator, all of the seams of coal 24 inches or over.

Senator GUFFEY. Thank you very much.

Congressman RANDOLPH. Mr. Ickes has broken down for the committee the number of years for which our oil reserves are available. Can we get a break-down for coal in the same way?

Dr. SAYERS. We can. As a matter of fact, we have indicated the amount of oil and fuel from all the coal we have in this country would last us over a thousand years.

Congressman RANDOLPH. I would like to ask you further: We have discussed the process of using coal for the manufacture of gasoline and fuel oil. What about rubber?

Dr. SAYERS. As I stated awhile ago, coal and rubber are both organic materials. Processes are available for making the raw materials for synthetic rubber from coal.

Congressman RANDOLPH. At the station here in Pittsburgh you have, of course, been experimenting for 7 or 8 years with hydrogenation of coal and fuel oils. Are you working on the subject matter of coal into rubber?

Dr. SAYERS. Not here at Pittsburgh.

Congressman RANDOLPH. Do you think it could be done?

Dr. SAYERS. It probably could be done. We are working on this problem in another station.

I am not so sure whether you want to put this into the record, or not. May I say something off the record?

Senator O'MAHONEY. Off the record.

(Discussion off the record.)

Congressman RANDOLPH. You would say, on the record, that the experimental work in the use of coal for rubber substitutes could be carried forward?

Dr. SAYERS. Yes; and similar products.

Congressman RANDOLPH. In other words, the entire field of research you believe needs to be intensified?

Dr. SAYERS. I certainly do.

Congressman RANDOLPH. It pays dividends?

Dr. SAYERS. Big dividends.

Congressman RANDOLPH. One final question and I am through. As I understand it, the work carried on by Dr. Storch here in Pittsburgh and others indicate that the bituminous coal, high-volatile A or B, that the products, that is, the production of oil is of great figures?

Dr. SAYERS. That is correct.

Congressman RANDOLPH. But we come to the subbituminous coals and then it drops very precipitously?

Dr. SAYERS. That is correct.

Congressman RANDOLPH. Therefore, we are to deduce that the cost will actually be more in the production of fuel oils from the low type of coal—or the opposite? Or, what is the actual answer?

Dr. SAYERS. As a matter of fact, we don't know. That is one of the reasons for the bill. All the factors should be put in it and weighed.

Congressman RANDOLPH. I think that answers the question. That certainly is a reaffirmation of my feeling of the need for this sort of legislation, to actually get underneath this problem and tear it apart. And the Federal Government certainly will not be invading the field of private industry by doing it, but simply will be in a position of leadership. I know certainly that Senator O'Mahoney, if I might express what I hope is in his heart, he is trusting that private industry in all these various fields will join hands with the Government and make these experimental sources available to the American people.

And through your bill I think you are the spearhead.

Senator O'MAHONEY. I think that it is essential that that cooperation should be worked out.

Senator GURNEY. There is one point I want to bring out; that is, coming from an agricultural State, South Dakota, our farmers are very much interested in transportation costs, because the flour that we sell to the folks in Pittsburgh brings us around 10 or 15 cents a bushel less than if we had our market right in the area where the wheat is grown; we have talked about 5 cents a gallon for gasoline, and 6 cents a gallon—I think at present it is a little bit above 6 cents a gallon; I don't believe we have to compare the cost of making gasoline out of coal by the people of this area, with the cost in the oil fields.

In other words, we aren't so far off. It is nearer than is indicated by a comparison of the 6-cent price with the 12- or 15-cent price.

As I understand it, the railroad charges would be around 3 to 3½ cents a gallon into this area. You have got a handling cost of 1 to 2 cents a gallon, and a profit to the distributors in order to have these filling stations available, and whatnot; you have got 2 or 3 cents more

there. Undoubtedly a total cost at the moment, without the Federal and State taxes, laid down f. o. b. Pittsburgh would be 12 to 13 cents a gallon.

So each gallon can be made in the consumption area at around 10 or 12 cents. We aren't so far away from the economic use of it at the present. Do you agree with that?

Dr. SAYERS. I agree with you; yes, sir.

Senator GURNEY. Those are approximate figures, but I did want to bring that point out.

Senator O'MAHONEY. Dr. Maize, do you care to ask any questions as the representative of the Governor?

Dr. MAIZE. Not at the present time, Mr. Chairman.

I will have a statement later.

Senator O'MAHONEY. Mr. Tucker?

Mr. TUCKER. No questions, Mr. Chairman.

Senator O'MAHONEY. Mr. Kerr?

Mr. KERR. Not now; no, sir.

Senator O'MAHONEY. Senator Davis, you indicated you wanted to ask another question.

Senator DAVIS. Yes.

Doctor, it has been about 7 years since I was in the Ruhr district and inspected these coal mines. Can you refresh my memory as to the thickness of the seam in that particular district?

Dr. SAYERS. I think Dr. Fieldner can. The thickness of the seam in the Ruhr, Doctor?

Dr. FIELDNER. No; I wouldn't be able to give you a figure on that because I haven't been down in the Ruhr coal mines.

Senator DAVIS. Can you get it and put it into the record for us?

Dr. SAYERS. I can put it in the record; yes, sir.¹

Senator DAVIS. I would like also to know the productive manpower.

Dr. SAYERS. I will put that in; yes, sir.

Senator DAVIS. Tons per man.

Dr. SAYERS. Yes.

Bureau of Mines Bulletin No. 414, Coal Mining in Europe, by George S. Rice and Irving Hartmann, gives the following data for the production of coal per man shift in various countries

[Comparison of production per man per day, in short tons¹]

Country	Per underground worker				Per underground and surface worker			
	1913	1930	1932	1935	1913	1930	1932	1935
Great Britain.....	1.28	1.56	1.59	1.70	1.03	1.20	1.21	1.28
France.....	1.08	1.08	1.27	1.47	.77	.76	.86	.96
Belgium.....	.81	.91	.99	1.25	.58	.63	.67	.85
Germany (Prussia) ²	1.32	1.77	2.14	2.19	.97	1.33	1.55	1.57
Czechoslovakia ²						1.13	1.17	1.60
Poland.....						1.40	1.57	1.95
United States:								
Bituminous.....	4.17	5.60	5.80	5.05	3.61	5.06	5.23	4.52
Anthracite.....	2.79	2.69	2.96	3.04	2.03	2.20	2.56	2.71

¹ Data for Czechoslovakia and Poland from Reichskohlenrat, 1936 report; for other countries, from W. W. Adams, Bureau of Mines.

² Not including brown coal and lignite.

¹ Dr. Sayers subsequently advised the committee that "minable coal beds in the Ruhr vary from 1.3 to 6.6 feet in thickness."

Senator DAVIS. It is less in Germany compared with the United States.

Dr. SAYERS. I can put that in very readily; yes, sir.

Senator O'MAHONEY. Thank you very much, Doctor. We appreciate your testimony.

The next witness is Dr. Storch. I will introduce Dr. Storch to the audience by saying that he is the principal physical chemist for the Bureau of Mines and that he and Dr. Schroeder made a visit to England recently at the suggestion of the Bureau of Mines and this committee to make a personal study of the British use of the hydrogenation process.

Doctor, we will be very glad to hear from you.

**STATEMENT OF H. H. STORCH, PRINCIPAL PHYSICAL CHEMIST,
BUREAU OF MINES, DEPARTMENT OF THE INTERIOR**

Dr. STORCH. Mr. Chairman, Senators and Congressmen: I am going to omit a considerable section of the prepared statement.

I am going to omit particularly the details of the historical development of synthetic fuels in Germany and also considerable detail about the nature of the processes.

Senator O'MAHONEY. Perhaps you would care to summarize it.

Dr. STORCH. I will as I go along.

Senator O'MAHONEY. The full statement, however, will appear in the record.

Dr. STORCH. The full statement is available.

One of the many outstanding achievements of modern science is the liquefaction of coal. The chemical transformation of coal into aviation fuel, Diesel oil, lubricating oil, and paraffin wax has not yet assumed industrial importance in the United States because of the discovery of large petroleum deposits.

In Germany, where only small deposits of petroleum have been discovered, there has been since about 1932 a Government-subsidized large-scale development of coal hydrogenation, which was essentially a part of Germany's rearmament program. The discovery of new petroleum deposits in the United States during the past 4 years has not been sufficient to replace that which has been produced and consumed.

New deposits have been discovered at about the same rate as in previous years, but the total yield of oil from such discoveries has been too low to replace more than about one-fourth of the oil produced and consumed. Because of the importance of oil for military purposes, it is not safe to assume that our rate of discovery of new oil deposits will increase in the immediate future. Indeed, it is quite apparent that we must develop as soon as possible, the production of synthetic liquid fuels from coal and oil shale if we wish to be sure of an adequate oil supply produced within the United States for our armed forces, and for essential industrial purposes.

When heated at about 870° F. with hydrogen gas under a pressure of 3,000 to 5,000 pounds per square inch, coal undergoes a chemical transformation involving an increase in its hydrogen content and the elimination of the oxygen, nitrogen, sulphur, and ash of the coal. The coal is thus converted into an oil resembling an aromatic petroleum crude oil. The cracking and refining of this synthetic crude oil

is in all respects quite similar to that now used for petroleum oils. The art of producing from coal by this direct hydrogenation process a high-octane number aviation fuel containing a relatively large proportion of aromatics so as to provide an excellent rich mixture rating is now known to engineers in Great Britain and the United States.

Another but more indirect process for accomplishing the transformation of coal into oil is also known. It consists in subjecting the coal to the action of steam at elevated temperatures so as to produce a mixture of hydrogen and carbon monoxide gases known as water-gas. The gas when freed from sulphur-bearing impurities and contacted with finely divided cobalt or iron at 400 degrees Fahrenheit and 100 pounds per square inch undergoes a transformation whereby an oil is produced. This oil upon refining yields an excellent Diesel oil of more than 100 octane number, a relatively poor gasoline of about 50 octane number, and some paraffin wax.

Detailed plant designs can be made available in a relatively short time for both of these processes.

As may be noted from the description of the Bergius and the Fischer processes, they are complementary rather than competitive. Thus, the former yields high-octane gasoline, with a relatively large proportion of aromatics, but only a mediocre Diesel oil, largely because of the high aromatic content. The Fischer-process oils contain only traces of aromatic hydrocarbons and yield an excellent Diesel oil but a relatively poor gasoline, which must be re-formed before it is suitable for high compression engines. The Fischer-process oils can be used as raw material for producing high-grade lubricating oil, whereas it is not possible to produce good lubricating oil from the products of the Bergius process.

Since 1937 the Bureau of Mines has been assaying some of the more important coal beds of the United States as to their amenability for use in the Bergius process. This assay work was done in a small laboratory plant using 100 pounds of coal a day. Information recently obtained from the Imperial Chemical Industries, Ltd., in Billingham, England, shows that while results from a laboratory are a valuable index of the probable behavior of any particular coal, they cannot be safely applied to commercial-size operation.

One important problem in the first stage of hydrogenation of bituminous coal has not yet been satisfactorily solved—the development of a completely satisfactory heavy oil from sludge recovery process. This can be done best on a fairly large scale. To solve this problem, to test improvements developed in the experimental plant, and to obtain assays on a commercial scale it is recommended that a plant capable of producing 200 to 500 tons (1,400 to 3,500 barrels) of gasoline a day be erected.

It is recommended that the size of our present experimental plant and laboratory be greatly increased at the same time to speed up obtaining of the data required for the design and operation of the demonstration plants.

Senator O'MAHONEY. Doctor, would you care to estimate what it would cost to build such a plant?

Dr. STORCH. It would cost approximately \$50,000,000 to build a plant to this size.

Senator GURNEY. That is the actual plant? It does not include operating cost?

Dr. STORCH. No; that does not include operating cost. That is the installation of the plant, itself.

Senator O'MAHONEY. What are the factors which make it so expensive?

Dr. STORCH. The converters are very large, high-pressure vessels; they are about 6 feet in diameter and 30 feet high, and they are expensive to construct.

There are large numbers of expensive machines, compressors and liquid pumps of one kind and another that add up to considerable amounts of money.

The cost of the Billingham-England plant in 1935 was approximately \$25,000,000.

Since then there has been an increase in the cost of labor and materials so that to erect a plant of only half the size of Billingham would cost more than it cost to erect the Billingham plant.

Senator O'MAHONEY. What was the source of the Billingham investment in the Billingham plant? Do you know?

Dr. STORCH. The money was put up entirely by Imperial Chemical Industries, but was not put up until the Government had guaranteed a certain subsidy per gallon on the synthetic gasoline.

Senator O'MAHONEY. So that the initiation of the hydrogenation process in Great Britain was made possible only by the cooperation of the Government in guaranteeing a sufficient price for the product to enable the chemical companies to justify the investment to the stockholders?

Dr. STORCH. That is correct.

Senator GURNEY. This plant you are recommending, up to 3,500 barrels a day, is that the same size as the Billingham plant?

Dr. STORCH. 3,500 barrels per day is the approximate capacity of the Billingham plant.

Senator O'MAHONEY. You may proceed.

Dr. STORCH. In 1928 to 1930 the Bureau of Mines developed an active iron-copper catalyst for the Fischer-Tropsch process. Because of lack of funds, this research was discontinued. In 1942 funds were appropriated by Congress for further experimental work on this process. About 6 months of experimental work on iron and cobalt catalysts has been done, using three shifts a day and six catalyst-testing units. An engineering laboratory for development of process improvements and for pilot-plant operation on the scale of a few gallons of oil a day is being completed.

In spite of the fact that this testing has been on a very small scale, the results have been most promising, both with respect to the development of better catalysts and in the simplification of the engineering design of the plant. Changes in either factor can reduce the initial cost of the plant and ultimately the cost of the final product.

Development of better methods of removal of heat from the synthesis reactions can materially reduce the size of converters. Improvement in the catalysts can speed up the reactions and may make it possible to produce a good Diesel fuel or a high-octane gasoline at will. With

the funds available, the Bureau is pushing its laboratory scale research as vigorously as possible to develop the Fischer-Tropsch process in these directions.

Further work on this process should expand the laboratory studies and should provide a pilot plant capable of producing about 7,000 barrels of primary product annually, in which the newly developed ideas could be tested on a commercial scale. After completion of a minimum amount of design and operating experimentation, a demonstration plant capable of producing about 300,000 barrels of primary products per year should be erected and operated so as to secure reliable engineering and cost data. Sufficient information has been provided to the Bureau engineers to make it possible to build the demonstration plant necessary for this purpose.

Congressman RANDOLPH. Mr. Chairman, may I interrupt at this point?

Senator O'MAHONEY. Certainly.

Congressman RANDOLPH. Where you speak of the productivity of a commercial plant of 300 000 barrels a year, if we were to break that down to say, 30,000 barrels a day, what would be the net production of light oils, medium oils, and heavy oils, together with other products that might come from that operation?

Dr. STORCH. Well, I can answer that question best by giving you the percentage distribution of the various production. You see, this primary product from the Fischer process is subsequently refined and separated to several different refined products.

Congressman RANDOLPH. Does that show in your statement?

Dr. STORCH. Yes; it does.

Congressman RANDOLPH. I withdraw the question then and allow your statement to answer it.

Dr. STORCH. Yes; it is in the prepared statement.

Congressman RANDOLPH. Very well.

Senator O'MAHONEY. Senator Guffey?

Senator GUFFEY. Doctor, what will that 7,000-barrel-annually plant cost? The first experimental plant?

Dr. STORCH. That is a relatively small pilot plant and will cost approximately \$3,000,000.

Senator GUFFEY. I wonder if the 7,000-barrel plant would be of sufficient size to get enough information to justify the building of the 300,000-barrel plant? I am for it, but I want to see if you could justify it with the smaller expenditure.

Dr. STORCH. We recommend the larger plant as necessary to get accurate costs and engineering data. It isn't possible to get accurate costs and engineering data from the 7,000-barrel-a-year plant.

The 7,000-barrel-a-year plant is designed to test new improvements in design and operating technique, but in order to get cost figures and engineering data suitable for large-scale development, the 300,000-barrels-a-year plant is essential.

Senator GUFFEY. Can you estimate what the 300,000-barrel-a-year plant will cost?

Dr. STORCH. Yes; it will cost about twelve million dollars.

Senator GUFFEY. Thank you very much.

Senator O'MAHONEY. You may proceed.

Dr. STORCH. Industrial development of the Fischer-Tropsch process in the United States, using cheap natural gas such as is available in the Kansas and Texas fields, is imminent.

The cost of production per gallon of gasoline and Diesel oil, with natural gas at 5 cents per 1,000 cubic feet, was given by the Standard Oil Co. of New Jersey in 1942 as about 9 cents. In some areas natural gas may be obtained for less than 3 cents per 1,000 cubic feet, so that the cost per gallon of gasoline and Diesel oil should be about 8 cents.

Natural gas at 3 cents per 1,000 cubic feet is equivalent to coal at about 60 cents per ton. Some of the huge deposits of subbituminous coal in our Western States can be mined and delivered even at this low cost.

Possible improvements in the catalysts and in the engineering features of the process may reduce the production cost by a few cents per gallon. Hence, in view of the probable increase in cost of gasoline from petroleum, which is now held at 5 to 6 cents per gallon, the Fischer-Tropsch process probably will be developed on a large scale in the near future in cheap natural-gas or coal areas.

Senator GUFFEY. Doctor, in what areas can you now get natural gas that is available to market at 3 cents a thousand?

Dr. STORCH. In Kansas.

Senator GUFFEY. How big is the field? I am asking for information.

Dr. STORCH. I can't answer—I can't answer that question as to how big the field is, but I was told by representatives from the Kansas Research Foundation who visited us recently that they had relatively large quantities of natural gas available at 3 cents a thousand, or would be glad to get that price for it.

Senator GUFFEY. Well, of course, that means a waste, Doctor.

Dr. STORCH. It does.

Senator GUFFEY. It means a waste when you sell it at 3 cents.

Dr. STORCH. As a matter of fact, there is some question from a conservation angle as to whether natural gas should be used at all for making gasoline. It is a premium fuel in its present state, and if it is at all possible to store it, it should not be used for making gasoline. It should be stored and used for its special and particular value.

There may, however, be places in the country where it is not possible to satisfactorily store large quantities of gas which are evolved during the production of oil and petroleum, and which may therefore be economically and satisfactorily used for making gasoline by the Fischer process.

Senator GUFFEY. They burned wheat in his State [indicating Senator Gurney] because they could not get a price for it. When you sell gas for 3 cents, it is like burning wheat.

Congressman RANDOLPH. Is it not a fact, Doctor, that Pennsylvania and West Virginia bituminous coal is the very best for the hydrogenation process?

Senator O'MAHONEY. Don't forget Utah and Wyoming and South Dakota.

Dr. STORCH. A great deal depends on from what angle you wish to classify the coals. If you classify the coals from the point of view of the highest yield per ton of coal mined, it is unquestionably true that the high-volatile bituminous coals are the best coals to use.

If you classify the coals on the basis of the engineering difficulties that are involved in the operation of a large-scale plant, I wish to point out that the problems involved in the hydrogenation of bituminous coals have not yet been completely solved, in either Germany or England or the United States, and that a considerable period of years of large-scale experimentation is necessary before those problems can be solved.

If I were asked to erect a large-scale hydrogenation plant, or to advise such erection in the United States, I should not advise such erection on the basis of the use of high volatile A bituminous coals.

I should definitely advise the erection of such a plant for the use of subbituminous coals such as the Monarch bed coal in Wyoming.

Senator O'MAHONEY. A very excellent answer.

Congressman RANDOLPH. It looks as though I asked a question favorable to Pennsylvania and West Virginia and received an answer favorable to Wyoming.

You should be very happy for the leading question.

Senator O'MAHONEY. Congressman, you have always been most gracious.

Congressman RANDOLPH. Thank you.

I do want to say very earnestly that this whole experimental program contemplated under the legislation and the resulting flow from the passage of the act would give to us and to the Bureau of Mines the information as to the amenability of the coal beds of the country to the hydrogenation process.

Isn't that true, Doctor?

Dr. STORCH. That is correct.

Congressman RANDOLPH. So, as you testified here today, you are not exactly certain as to whether the experimental plant would best be constructed in this territory or in the far West?

Dr. STORCH. That is correct.

Senator GUFFEY. Don't you think the experimental plant should be placed in the district from which you could bring more of this type of coal than in a place where you are limited to one type?

Dr. STORCH. I believe that, from the point of view of obtaining additional funds for the erection of further plants, it is essential that the minimum amount of difficulty be encountered in the operation of the first plant.

That is, nothing succeeds like success, and you are courting a lot of trouble if you start out by the hydrogenation of bituminous coals.

Billingham had plenty of that trouble during the first 5 or 7 years.

Congressman RANDOLPH. Doctor, you would say, however, looking at this whole picture of the best location for the experimental program, that when you select say, the subbituminous or lignite territory as the base of operations, you must necessarily remember that if such a plant were located in this territory, the transportation cost, or subject matter, would enter in, as well as the production of oils from coals; isn't that true?

Dr. STORCH. That is correct. There is no reason why the plant cannot be located at any place that seems desirable. It is an experimental plant and coals can be shipped to it.

I am merely pointing out that there are certain problems, difficult engineering problems in connection with bituminous coal that we have

yet to solve, and that is why we are asking for funds to enable us to get the solution of the problem, among others.

Senator GUFFEY. Which would be the best coal to start the experiment with? Do you think that the Montana, Wyoming, or Utah is better than the eastern coal?

Dr. STORCH. I would very definitely recommend that from the standpoint of minimum engineering difficulty, we should pick a subbituminous coal of relatively low ash, low fusain and low opaque matter content, and the Monarch coal from the Monarch bed is one such coal.

Senator GUFFEY. That is in Wyoming?

Dr. STORCH. Yes; there are other beds, of course. The Monarch bed is not the only one. There are beds in Colorado and Montana as well.

Senator GURNEY. How about the Dakotas?

Dr. STORCH. The Dakota lignites are another large group of coals that come into the picture.

(Discussion off the record.)

Congressman RANDOLPH. Honestly, Doctor, is it not a fact that the selection of experimental plants cannot at this time actually be determined on the basis of the knowledge that you now have?

Dr. STORCH. That is correct. It has to be gone over by several experts, not only technical experts, not only chemists, but engineers and also from an economic angle, the geographic location of water, and so forth, comes into the picture.

Congressman RANDOLPH. I would like to say, Senator O'Mahoney, that I am sure, the House, which I trust will support your measure, will, of course, not look upon favorable action on the basis of a district or selfish interests. This over-all picture is of interest and I think, as we develop these hearings, we will elicit from the witnesses information to build a background on which later perhaps we can proceed.

Senator O'MAHONEY. Since we have had this talk more or less facetiously among the members of the committee, perhaps it is appropriate to say that the audience may understand that the measure which the committee is studying does not attempt to control the judgment of the Bureau of Mines or the Secretary of the Interior with respect to the selection of the site. The committee and the sponsor of the bill are concerned primarily in promoting the fundamental objective, which is the development of new sources of synthetic fuel, wherever they may be.

Senator DAVIS. I might add that my colleague and myself, who are on the special committee to develop a laboratory for the anthracite region, after the Senate had passed the bill we decided to leave it to the Bureau of Mines as to where the location would be. We didn't care where they located, just so long as they located it some place in the anthracite region.

Senator MURDOCK. May I ask this question: Doctor, I think you stated that you had different engineering problems and the experience of the plant in England has shown difficult engineering problems in your bituminous coal?

Dr. STORCH. That is correct.

Senator MURDOCK. Then the question occurs to me why do you select a subbituminous coal to solve the difficulties with which you expect to be confronted with, from bituminous coal?

Dr. STORCH. We are not attempting to solve those difficulties by the use of a subbituminous coal in a large demonstration plant. I

was merely stating that if you wanted a demonstration plant to run with a minimum of difficulty, that is, if you wanted a big plant to show people how coal can be converted to oil and at what cost, and you wanted to get that up as soon as possible, with a minimum of operating troubles, you would not pick a bituminous coal but you would much prefer subbituminous coal.

Now, if, however, your objective is to solve the problems involved in the hydrogenation of bituminous coal you definitely would not work with the subbituminous coal.

Senator MURDOCK. That is the point I have in mind.

Dr. STORCH. That is correct.

Senator MURDOCK. That prompts this question: Where can we expect and from which grade of coal would you expect the greatest volume of gasoline or other liquid fuels from this subbituminous or bituminous coal?

Dr. STORCH. The largest yields are obtained from the bituminous coals. The largest yield per ton of coal mined is obtained from the bituminous coals.

Senator GURNEY. Of course, the objective, the purpose of the bill, is to find a source of supply of fuel for an internal combustion engine. The bill does not contemplate developing coal in any one particular area. The objective is to get motor fuel. With that objective in mind, it would be up to the engineers and the chemists to properly locate that experimental plant.

Dr. STORCH. Yes. There is a strategic factor involving geographic location of plants. You want plants all over the country eventually. You won't confine them to any one area.

Senator MURDOCK. In a plant for the treatment of your subbituminous coals, could you overcome the engineering difficulties that would be presented by bituminous coal?

Dr. STORCH. No; unless you shipped the bituminous coal to the plant for actual running and testing.

Senator MURDOCK. But it could be done if it was transported to the plant?

Dr. STORCH. That is correct.

Senator GUFFEY. Would the testing of different coals involve much change in the construction of the plant?

Dr. STORCH. No; practically none.

Senator GUFFEY. You could test them all in the same plant, in your opinion?

Dr. STORCH. That is correct.

Senator O'MAHONEY. You may continue, Doctor.

Dr. STORCH. In summarizing, I wish to say that the economic welfare of the United States, in time of peace or war, depends to a high degree on an ample supply of liquid fuels. This country cannot afford to risk a threatened shortage, whether it is imminent or more remote, without taking every step to meet the difficulty. By developing the Bergius process for the hydrogenation of coal and the Fischer synthesis liquid, fuels can be supplied from natural gas and from our huge reserves of coal and lignite; these latter materials are sufficient to provide liquid as well as solid fuel for combustion purposes for over 1,000 years.

The development of a synthetic-liquid-fuel industry based on coal as a raw material involves a very large and time-consuming program

of plant construction. To fabricate all of the plants necessary to produce the equivalent of our present petroleum consumption of 1,400,000,000 barrels per year would require about 10 years of work by all of the fabricating companies now in existence in the United States and about 75,000,000 tons of steel. It is, of course, impractical to use the entire fabricating capacity of the United States for synthetic-fuel plant construction, and it is, therefore, apparent that 30 to 40 years may be required for the completion of all the necessary plants. During this construction period we would have available our oil-shale reserves for making up any deficiency of oil due to dwindling petroleum supplies. However, the important fact to remember is that because we have only about 50 years' supply of oil available in our oil-shale deposits, and because the erection and bringing into satisfactory operation of the necessary oil-from-coal plants will require 30 to 40 years, there is no time to be lost in starting the erection of these plants. This start should be made as soon as possible.

Although the extraction of oil from oil shale has not been considered in this report, it seems logical to view our deposits of shale, which are not now utilized, as another source of substitute liquid fuels. The best methods of obtaining gasoline and oil from shale should be developed along with the Bergius and Fischer processes for making these materials from coal and lignite.

When these three processes have been developed through the engineering stages to the point of commercial application, this country will be well fortified to meet any threatened liquid-fuel shortages. Plans will be available for the construction of plants to operate on the most suitable raw materials in any section of the country. These same plans can be used to build plants in many areas of strategic military importance and to supply liquid fuels to our armed forces, independent of long transportation routes over land or water.

(Following is a supplemental letter received from Dr. H. H. Storch:)

UNITED STATES DEPARTMENT OF THE INTERIOR,
CENTRAL EXPERIMENTATION STATION, BUREAU OF MINES,
Pittsburgh, Pa., August 11, 1943.

HON. JOSEPH C. O'MAHONEY,
Chairman, War Minerals Subcommittee,
Committee on Public Lands and Surveys,
United States Senate, Washington, D. C.

Subject: Revision of statement made by H. H. Storch to the War Minerals Subcommittee on August 6, 1943.

MY DEAR SENATOR O'MAHONEY: In answer to questions put to me by members of your committee in Pittsburgh on August 6, 1943, I stated the following costs of installation:

Bergius high-pressure hydrogenation plant, 1,750-barrels-of-gasoline-per-day capacity-----	\$30, 000, 000
Fischer-Tropsch synthesis of oil from water-gas pilot plant, 20-barrels-per-day capacity-----	300, 000
Fischer-Tropsch synthesis of oil from water-gas plant, 830-barrels-per-day capacity-----	8, 000, 000

These estimates are based on 1935-37 cost data. Conversion to probable costs as of 1943 yields the following estimates:

Bergius, 1750-barrels-per-day plant-----	\$50, 000, 000
Fischer-Tropsch, 20-barrels-per-day plant-----	3, 000, 000
Fischer-Tropsch, 830-barrels-per-day plant-----	20, 000, 000

I would greatly appreciate it if you will incorporate this letter in the record of the hearings held on August 6, 1943, in Pittsburgh. Because I am not sure that a copy of my prepared statement was submitted for the record, I am sending a copy herewith. This copy includes some minor changes, and I would prefer to have it substituted for any written statement by me which may now be in the record.

Sincerely yours,

H. S. STORCH,
*Supervising Physical Chemist,
Physical Chemistry and Hydrogenation Section.*

SYNTHETIC LIQUID-FUEL PROCESSES—THEIR DEVELOPMENT IN GERMANY AND GREAT
BRITAIN AND A SUGGESTED PROGRAM FOR THE UNITED STATES

By H. H. Storch, Principal Physical Chemist, Bureau of Mines, United States
Department of the Interior

PRESENT STATE OF THE ART

One of the many outstanding achievements of modern science is the liquefaction of coal. The chemical transformation of coal into aviation fuel, Diesel oil, lubricating oil, and paraffin wax has not yet assumed industrial importance in the United States because of the discovery of large petroleum deposits. In Germany, where only small deposits of petroleum have been discovered, there has been since about 1932 a government-subsidized large-scale development of coal hydrogenation, which was essentially a part of Germany's rearmament program. The discovery of new petroleum deposits in the United States during the past 4 years has not been sufficient to replace that which has been produced and consumed. New deposits have been discovered at about the same rate as in previous years, but the total yield of oil from such discoveries has been too low to replace more than about one-fourth of the oil produced and consumed. Because of the importance of oil for military purposes, it is not safe to assume that our rate of discovery of new oil deposits will increase in the immediate future. Indeed, it is quite apparent that we must develop as soon as possible the production of synthetic liquid fuels from coal and oil shale if we wish to be sure of an adequate oil supply produced within the United States for our armed forces and for essential industrial purposes.

When heated at about 870° F. with hydrogen gas under a pressure of 3,000-5,000 pounds per square inch, coal undergoes a chemical transformation involving an increase in its hydrogen content and the elimination of the oxygen, nitrogen, sulfur, and ash of the coal. The coal is thus converted into an oil resembling an aromatic petroleum crude oil. The cracking and refining of this synthetic crude oil is in all respects quite similar to that now used for petroleum oils. The art of producing from coal by this direct hydrogenation process a high octane number aviation fuel containing a relatively large proportion of aromatics so as to provide an excellent rich mixture rating is now known to engineers in Great Britain and the United States.

Another but more indirect process for accomplishing the transformation of coal into oil is also known. It consists in subjecting the coal to the action of steam at elevated temperatures so as to produce a mixture of hydrogen and carbon monoxide gases known as water gas. This gas when freed from sulfur-bearing impurities and contacted with finely divided cobalt or iron at 400° F. and 100 pounds per square inch undergoes a transformation whereby an oil is produced. This oil upon refining yields an excellent Diesel oil of more than 100 cetene number, a relatively poor gasoline of about 50 octane number, and some paraffin wax.

Detailed plant designs can be made available in a relatively short time for both of these processes.

DEVELOPMENT OF THE BERGIUS-I. G. PROCESS IN GERMANY AND GREAT BRITAIN

In 1913 F. Bergius, a German chemist, discovered that coal could be liquefied by the action of hydrogen at a pressure of about 3,000 pounds per square inch and at a temperature of about 480° C. (896° F.). In 1922 his experiments were carried into the pilot-plant stage, using 1 ton of coal a day. The oils obtained by coal hydrogenation using the original Bergius process were of poor quality

and high in oxygen, nitrogen, and sulfur compounds, and they consisted chiefly of the less-volatile high-molecular-weight hydrocarbons.

During the 1915-25 the I. G. Farbenindustrie A. G., the outstanding German chemical company, succeeded in finding catalysts that were not poisoned by the sulfur in the coal and that greatly increased the velocity of the desirable coal-hydrogenation reactions. They also divided the process into two stages, with different catalysts and optimum conditions for each stage. This company built the first commercial hydrogenation plant at Leuna in 1927. It was designed to produce 700,000 barrels per year of gasoline from brown coal, but at first it was operated mostly on low-temperature brown-coal tar and on German crude petroleum.¹ The applicability of the process to the petroleum industry was soon recognized, and commercial plants were built in the United States for gasoline and lubricating-oil production by high-pressure hydrogenation of petroleum.

During 1926-36, the German production of synthetic liquid fuels by hydrogenation of coal and coal tar increased to about 3,500,000 barrels per year. In 1938 the production was 12,500,000 barrels per year, and during the next 4 years this production was greatly increased and the present production is about 28,000,000 barrels of synthetic gasoline per year. This approximates one-third of the gasoline production the Germans are believed to have available for fighting this war.

Meanwhile, the original Bergius process had been considered for British conditions, and tests of British coals were made in Germany. The Imperial Chemical Industries, Ltd., modified the process to produce gasoline only in place of gasoline, tar acids, heavy oil, and pitch. This process started with bituminous coal, as it was unlikely that tar, whether from low- or high-temperature carbonization, would ever be available in sufficient quantities to make any large proportion of the country's oil supply.

Experimental work at Billingham started early in 1927, and in 1929 a pilot plant to treat 10 tons of coal a day was built. This plant was operated from 1929 to 1931.

In July 1933 the British Government announced its intention to guarantee the continuance of certain tax-free provisions on light oils made from indigenous materials for a period of years by means of the British hydrocarbon oils production bill. This enabled Imperial Chemical Industries to undertake the erection of a commercial coal-hydrogenation plant, which was completed in 1935. This plant has a capacity of about 1,050,000 barrels of gasoline per year, and its installation cost was about \$25,000,000. Two-thirds of the raw material used by this plant during 1935-39 was coal, and the remainder creosote oil and low-temperature tar. Most of the important operating difficulties were successfully solved.¹ However, there is ample scope for further research and development work.

DESCRIPTION OF BERGIUS-I. G. PROCESS

As practiced at Billingham during 1935-39, the coal hydrogenation process consisted in pumping a mixture of about equal parts of powdered coal and a recycle heavy oil with a very small amount of tin oxide and hydrogen, at 3,000 pounds per square inch, through a preheater into two high-pressure vessels in series. The light and middle oils formed in the converter are separated from the heavy oil by distillation and are carried, along with the excess hydrogen and hydrocarbon gases formed in the reaction, into a heat exchange and condenser system. Subsequently the oils are separated from the gases. The gases are scrubbed with oil under pressure to remove the bulk of the hydrocarbons, and the residual hydrogen is recycled to the preheater.

The heavy oil contains in suspension the ash-forming constituents and unreacted coal particles. About two-thirds of this slurry is directly recycled to the paste-preparation system, whereas the remaining third is centrifuged to remove a portion of its solids. The centrifuge oil and the oil recovered by a coking distillation of the centrifuge solids are recycled to the paste-preparation system.

The light and middle oils are separated into three fractions—gasoline, middle oil, and heavy oil. The last is recycled to paste preparation. The gasoline fraction obtained in this first stage (which is otherwise termed the "liquid phase") constitutes about 27 percent of the total gasoline yield and is of about 72 octane

¹ Gordon, Kenneth, *The Development of Coal Hydrogenation by Imperial Chemical Industries, Ltd.*; *J. Inst. Fuel*, vol. 9, 1935, pp. 69-89.

number, which is increased to about 84 by the addition of 3 cubic centimeters of tetraethyl lead per gallon.

The middle oil from the liquid phase is pumped with hydrogen, at 3,000 pounds per square inch, through a preheater into the "vapor phase" converters. These converters are of the same dimensions as the liquid-phase converters, but are filled with catalyst pellets. In passage over these catalysts the middle oil reacts with hydrogen to form water, ammonia, gasoline, and lower-boiling hydrocarbons, such as butane, propane, ethane, and methane. The gasoline obtained from this treatment has a high octane rating.

The liquefaction of 100 tons of moisture-and-ash-free bituminous coal produces about 55 tons of gasoline. An additional 100 tons of coal is necessary for generating power and steam.

DEVELOPMENT OF FISCHER-TROPSCH PROCESS IN GERMANY AND GREAT BRITAIN

In 1913 the Badische Anilin und Soda Fabrik in Ludwigshafen, Germany, discovered that hydrocarbons and oxygenated organic compounds could be synthesized from carbon monoxide and hydrogen under pressure at about 350° Centigrade (662° Fahrenheit), using alkalized heavy-metal catalysts. These experiments were discontinued because of the First World War. They were renewed in 1922 and led to the development of methanol synthesis.

In 1925 Fischer and Tropsch, of the Fuel Research Laboratory of the Kaiser Wilhelm Institute in Berlin, Germany, using very active catalysts consisting of metals of the iron group plus various activating agents, found it possible to produce from carbon monoxide and hydrogen, at atmospheric pressure and temperatures of about 200° Centigrade (412° Fahrenheit), gaseous, liquid, and solid hydrocarbons. In 1925 to 1933, German, British, American, and Japanese chemists developed active cobalt, nickel, and iron catalysts for this synthesis. In 1933 the Ruhrchemie A. G. erected a plant of 7,000 barrels of oil per year capacity at Oberhausen, Germany. At the end of 1936 there were five Fischer-Tropsch plants in Germany, with a total capacity of about 805,000 barrels of oil per year. During 1937-38 this capacity was doubled by the erection of new plants, and during 1939-42 it was again increased. The present yearly capacity of the German Fischer-Tropsch plants is about 5,590,000 barrels of gasoline, Diesel oil, lubricating oil, and paraffin wax. This is estimated at somewhat less than one-tenth of the oil production available to Germany.

In Great Britain the Fuel Research Laboratory at Greenwich has conducted extensive laboratory tests on the activity of cobalt catalysts and on the synthesis of lubricating oils from the lower-boiling oils produced in the Fischer-Tropsch process. British industrial organizations and Government committees have collected information on the engineering development and costs of operation of the process.

DESCRIPTION OF FISCHER-TROPSCH PROCESS

As practiced in Germany in 1939, this process consisted in first converting coal to a mixture of carbon monoxide and hydrogen by reaction with steam. This mixture of gases, in proper proportion and after suitable purification, was compressed to about 150 pounds per square inch and passed over an active cobalt catalyst at 185°-200° Centigrade (365°-412° Fahrenheit). The products comprise the following:

	<i>Percent</i>
Gasoline -----	52
Diesel oil -----	26
Wax -----	9
Bottled gas (propane, butane) -----	13

The gasoline boils up to 200° Centigrade (412° Fahrenheit) and has an octane number of about 50, which may be increased to about 62 upon addition of 1 cubic centimeter of tetra-ethyl lead per gallon. Re-forming this gasoline by thermal cracking results in about a 67 percent yield of gasoline of 70 octane number, which upon addition of 3.5 cubic centimeters of tetra-ethyl lead per gallon increases to 85. This fuel would be markedly inferior to the fuel produced by the Bergius process, particularly because of its very low aromatic content.

The highly paraffinic nature of the Fischer-Tropsch oils, while detrimental to their use, as high-grade aviation gasoline, is nevertheless of great value to their use as Diesel oil. The Diesel oil boils in the range, 200°-300° Centigrade (412°-572° Fahrenheit) and has a cetene value of over 100; even when diluted with an

equal volume of tar oils or heavy petroleum oils the resulting mixture is a satisfactory Diesel fuel.

One ton of the above-described products is obtained for every 5 tons of bituminous coal used for all purposes; that is to say, for gas, steam, and power. The cost of production per gallon of oil was estimated in 1940 to be about 18 cents per gallon. A much lower cost, namely, about 9 cents per gallon, may be attained if natural gas is available at 5 cents per 1,000 cubic feet, or coal at about \$1 per ton for the production of synthesis gas.

COMPLIMENTARY NATURE OF TWO PROCESSES

As may be noted from the description of the Bergius and the Fischer processes, they are complimentary rather than competitive. Thus, the former yields high-octane gasoline, with a relatively large proportion of aromatics, but only a mediocre Diesel oil, largely because of the high aromatic content. The Fischer-process oils contain only traces of aromatic hydrocarbons and yield an excellent Diesel oil but a relatively poor gasoline, which must be re-formed before it is suitable for high-compression engines. The Fischer-process oils can be used as raw material for producing high-grade lubricating oil, whereas it is not possible to produce good lubricating oil from the products of the Bergius process.

SUGGESTED DEVELOPMENT PROGRAM FOR THE UNITED STATES—BERGIUS-I. G. PROCESS

Since 1937 the Bureau of Mines has been assaying some of the more important coal beds of the United States as to their amenability for use in the Bergius process. This assay work was done in a small laboratory plant using 100 pounds of coal a day. Information recently obtained from the Imperial Chemical Industries, Ltd., in Bellingham, England, shows that while results from a laboratory are a valuable index of the probable behavior of any particular coal, they cannot be safely applied to commercial-size operation.

One important problem in the first stage of hydrogenation of bituminous coal has not yet been satisfactorily solved—the development of a completely satisfactory heavy-oil-from-sludge recovery process. This can be done best on a fairly large scale. To solve this problem, to test improvements developed in the experimental plant, and to obtain assays on a commercial scale, it is recommended that a plant capable of producing 200 to 500 tons (1,400 to 3,500 barrels) of gasoline a day be erected. It is recommended that the size of our present experimental plant and laboratory be greatly increased at the same time to speed up obtaining of the data required for the design and operation of the demonstration plants.

FISCHER-TROPSCH PROCESS

In 1928 to 1930 the Bureau of Mines developed an active iron-copper catalyst for the Fischer-Tropsch process. Because of lack of funds, this research was discontinued. In 1942 funds were appropriated by Congress for further experimental work on this process. About 6 months of experimental work on iron and cobalt catalysts has been done, using three shifts a day and six catalyst-testing units. An engineering laboratory for development of process improvements and for pilot-plant operation on the scale of a few gallons of oil a day is being completed.

In spite of the fact that this testing has been on a very small scale, the results have been most promising, both with respect to the development of better catalysts and in the simplification of the engineering design of the plant. Changes in either factor can reduce the initial cost of the plant and ultimately the cost of the final product. Development of better methods of removal of heat from the synthesis reactions can materially reduce the size of the converters. Improvement in the catalysts can speed up the reactions and may make it possible to produce a good Diesel fuel or a high-octane gasoline at will. With the funds available, the Bureau of Mines is pushing its laboratory-scale research as vigorously as possible to develop the Fischer-Tropsch process in these directions.

Further work on this process should greatly expand the laboratory and engineering design work so as to include one or more pilot plants with a capacity of about 7,000 barrels of primary products per year. After completion of a minimum amount of design and operating experimentation, a demonstration plant capable of producing about 300,000 barrels of primary products per year should be erected and operated so as to secure reliable engineering and cost data.

Industrial development of the Fischer-Tropsch process in the United States, using cheap natural gas such as is available in the Kansas and Texas fields, is

imminent. The cost of production per gallon of gasoline and Diesel oil, with natural gas at 5 cents per 1,000 cubic feet, was given by the Standard Oil Co. of New Jersey in 1942 as about 9 cents. In some areas natural gas may be obtained for less than 3 cents per 1,000 cubic feet, so that the cost per gallon of gasoline and Diesel oil should be about 8 cents. Natural gas at 3 cents per 1,000 cubic feet is equivalent to coal at about 60 cents per ton. Some of the huge deposits of subbituminous coal in our Western States can be mined and delivered even at this low cost. Possible improvements in the catalysts and in the engineering features of the process may reduce the production cost by a few cents per gallon. Hence, in view of the probable increase in cost of gasoline from petroleum (which is now held at 5 to 6 cents per gallon), the Fischer-Tropsch process probably will be developed on a large scale in the near future in cheap natural-gas or coal areas.

SUMMARY

The economic welfare of the United States, in time of peace or war, depends to a high degree on an ample supply of liquid fuels. This country cannot afford to risk a threatened shortage, whether it is imminent or more remote, without taking every step to meet the difficulty. By developing the Bergius process for the hydrogenation of coal and the Fischer synthesis, liquid fuels can be supplied from natural gas and from our huge reserves of coal and lignite; these latter materials are sufficient to provide liquid as well as solid fuel for combustion purposes for over 1,000 years.

The development of a synthetic liquid fuel industry based on coal as a raw material involves a very large and time-consuming program of plant construction. To fabricate all of the plants necessary to produce the equivalent of our present petroleum consumption of 1.4 billion barrels per year would require about 10 years of work by all of the fabricating companies now in existence in the United States and about 75 million tons of steel. It is, of course, impractical to use the entire fabricating capacity of the United States for synthetic fuel plant construction, and it is therefore apparent that 30 to 40 years may be required for the completion of all the necessary plants. During this construction period we would have available our oil shale reserves for making up any deficiency of oil due to dwindling petroleum supplies. However, the important fact to remember is that because we have only about 50 years' supply of oil available in our oil shale deposits, and because the erection and bringing into satisfactory operation of the necessary oil-from-coal plants will require 30 to 40 years, there is no time to be lost in starting the erection of these plants. This start should be made as soon as possible.

Although the extraction of oil from oil shale has not been considered in this report, it seems logical to view our deposits of shale, which are not now utilized, as another source of substitute liquid fuels. The best methods of obtaining gasoline and oil from shale should be developed along with the Bergius and Fischer processes for making these materials from coal and lignite.

When these three processes have been developed through the engineering stages to the point of commercial application, this country will be well fortified to meet any threatened liquid fuel shortages. Plans will be available for the construction of plants to operate on the most suitable raw material in any section of the country. These same plans can be used to build plants in many areas of strategic military importance and to supply liquid fuels to our armed forces, independent of long transportation routes over land or water.

Senator O'MAHONEY. The Chair is advised that Mr. R. C. Tucker, State geologist of West Virginia, will not be able to be present at the hearing this afternoon because he must attend a meeting of the State planning board in West Virginia, and therefore must leave. With the consent of the members of the committee, therefore, we will postpone the questioning of Dr. Storch until the afternoon session and ask Mr. Tucker, who is the representative of the Governor of West Virginia, if he cares to take the stand and make any statement now.

The Chair wants to make note of the presence of Congressman Scanlon, of Pittsburgh, who is also vitally interested in this problem and has devoted considerable time and study to it.

You may proceed, Mr. Tucker.

STATEMENT BY R. C. TUCKER, ACTING STATE GEOLOGIST,
WHEELING, WEST VIRGINIA

MR. TUCKER. I might say in the beginning, that I did not have much information at our office as to the size of this plant; I had a call from the Governor to prepare some information for him, and he was supposed to be here and I was to make another statement.

Senator O'MAHONEY. You may be seated, Mr. Tucker.

MR. TUCKER. The figures and other information that I have in this paper are on the basis of a real plant, not one of these small ones. Of course, you will have to develop larger ones.

At the request of Hon. M. M. Neely, Governor of West Virginia, I have been asked to accept Dr. Price's invitation to appear before your committee since Dr. Price is now in the Army and has been granted a leave of absence as State geologist "for the duration." I might add that the invitation received by Dr. Price stated the meeting would be held at 10 a. m. but day and date were not stated.

West Virginia's original coal in the ground amounted to 116,618,446,894 short tons, as estimated by the West Virginia Geological Survey. It is contained in 62 seams minable in some portions of the State. There are 55 other seams of coal in the State which are not now considered of minable thickness. With 1943's production estimated, West Virginia has produced a total of 4,090,605,141 tons of coal or about $3\frac{1}{2}$ percent of her reserves. This production has been valued at the mines at \$6,997,981,925.53. The tables on pages 236-249 of volume XIII of the West Virginia Geological Survey show the estimated total original tonnage by minable seams; the estimated original tonnage in minable seams by counties; the total original coal by counties; and the estimated original tonnage in various counties by minable seams.

For comparison with other States, Pennsylvania's original bituminous tonnage is estimated by the Pennsylvania Geological Survey (Bulletin M-22) as 75,093,459,000 tons, contained in 15 seams, while the State of Ohio had an original tonnage of 10,399,296,000 on proved area, with an additional 4,000,000,000 tons estimated on unproved area, contained in 10 seams.

Based on the number of days worked, the mines in West Virginia could produce 25 to 50 percent more coal than at present, if the coal were needed. The production could also be increased if more men were employed in the industry, and they still worked the same number of days as at present.

There are 11 mines in the northern part of the State—may be more now if figures were available—producing coal at the rate of a million tons each annually, and one nearly at the 2,000,000 mark. These are located in Barbour, Brooke, Clay, Harrison, Marion, Monongalia, and Ohio Counties.

There are 26, may be more, in the southern part of the State producing from 750,000 tons to over a million tons each annually. These are located in Boone, Fayette, Kanawha, Logan, McDowell, Mercer, Raleigh, Randolph, and Wyoming counties.

There are many mines in the State producing annually a half-million tons of coal, and the production of these could be increased to such an extent they could supply the coal required for any oil

extraction plant which might be established in the State. I am assuming that as a minimum, such a plant would process at least a million tons of coal annually.

West Virginia has many grades of coal, but none of the poorest nor anthracite. From studies made by the United States Bureau of Mines on various grades of coal, some from West Virginia coals, it is believed the State can supply for an almost indefinite period the coal necessary to operate one or many hydrogenation plants, or any other kind of plant which may be built.

Volume XIII of the West Virginia Geological Survey on Characteristics of Minalable Coals of West Virginia, summarizes the results of a study of 4,908 analyses of channel samples collected from 2,528 mines, prospects, openings, outcrops, and drill cores representing 75 seams, as well as 1,089 analyses of tippie samples.

The analyses were made in the laboratories of the Geological Survey and United States Bureau of Mines. Under the description of each seam will be found a map showing the area of the State in which it is minable, a table showing the varying composition of the coal as determined from the number of analyses given, and a short description and section of the coal in each county. The figures showing minable areas have been reproduced on a single sheet, to which we have added in large black figures the estimated original tonnage in each seam.

From a study of tests made by the U. S. Bureau of Mines, the results indicate that the bright coals containing less than 89 percent carbon, hydrogenate readily, whereas dull coals containing a large quantity of opaque matter give relatively low yields of oil.

It is believed that the bituminous coals of West Virginia are of such quality insofar as both carbon content and banded constituents are concerned that hydrogenation would result in strong liquefaction yields.

Tests on coals such as we have in West Virginia show the following yields upon hydrogenation of 1 ton of coal: 1,300 to 1,400 pounds of oil; 460 pounds pitch residue; 240 pounds of gas, including losses. On distilling this oil it yielded 31 percent motor fuel, 41 percent Diesel oil, 16 percent fuel oil, 12 percent lubricating oil.

Hydrogenation of 1,000,000 tons of coal annually should average about 3,200,000 barrels of oil, distilling roughly into 1,000,000 barrels of motor fuel, 1,300,000 barrels of Diesel oil, 515,000 barrels of fuel oil, and 385,000 barrels of lubricating oil.

If several such plants were to be established, it will readily be seen that the oil shortage we are experiencing would be relieved in short order.

Such figures as we were able to obtain on costs of hydrogenation and low-temperature carbonization plants are entirely out of date, but seem to indicate that about seven times as much coal can be processed by hydrogenation for the same cost of plant as by low-temperature carbonization.

It might be stated, as pointed out by H. H. Storch and A. C. Fieldner, of the United States Bureau of Mines, in a paper titled "Hydrogenation and Liquefaction of American Coals," presented in 1939 at the

Third American Coal Conference, and published in Technical Paper No. 15 of West Virginia University Bulletin:

The essential difference in the chemical composition of bituminous coal and petroleum is that the atomic ratio of carbon to hydrogen is about 1.2 for the former and 0.6 for the latter. Therefore, if hydrogen atoms were combined with the coal in sufficient quantities (that is, if the number of hydrogen atoms in bituminous coal were approximately doubled), a material similar to petroleum should be obtained.

This is the principle of hydrogenation, and by the addition of hydrogen to coal under higher than normal pressure—200 atmospheres and temperatures 450°C .—a liquid similar to petroleum is formed. Under these conditions, most of the oxygen in the coal is hydrogenated to form water, some of the nitrogen to form ammonia, most of the sulfur to form hydrogen sulfide, and enough additional hydrogen atoms are chemically combined with the coal substance to produce a liquid similar to petroleum. Catalysts are also employed in the process, covered by many patents.

The Eastern States have produced large quantities of high-grade oil, but production is steadily declining except in areas where secondary methods of recovery are in use, such as flooding, repressuring, and so forth.

West Virginia is estimated to have had 2,033,220,000 barrels of oil originally, and to have produced 420,745,710 barrels to the end of 1942, valued at \$915,854,870.

This would leave 1,612,474,290 barrels in the ground, of which it is estimated 232,216,000 barrels will be recovered by present producing methods, which include some repressured areas. Flooding will not be possible at present prices, except in shallow fields, since practically every field would have to be redrilled. A million-ton hydrogenation plant should yield about as much oil as the State is now producing from wells.

The oil and gas map of the State shows the location of the various oil and gas fields of the State, producing sands and depths as also the pipe-line facilities available. What we call our old coal, oil, gas, iron ore, and limestone map of the State shows the fields as they then existed, as also the area of the State underlain by coal, on a larger scale than the small map showing the minable areas for each seam.

Another map is presented showing the locations of the commercial coal mines of the State, the railroads on which they are located, with list of operators, names of mines, and seam operated.

For successful operation of a hydrogenation plant, it would appear that a suitable supply of coal should be available for a long period of time, transportation facilities should be adequate, pipe lines should be available, it should be located where the oil is needed at near-by markets or in areas where there is a shortage and where there is a market for the byproducts, and where water is abundant.

As previously stated, West Virginia has an abundant supply of coal suitable for the purpose; transportation for the raw materials and the finished products both by rail, river, and pipe line are available and adequate at many points in the State; the State is on the border line of the shortage area since a great part of its oil production is

refined outside the State and some of it reshipped into the State; and our rivers, with slack water available on the Monongahela, Ohio, and Kanawha Rivers, have an all-year-round supply of water in addition to furnishing cheap transportation.

It would seem, therefore, that West Virginia should receive due consideration in the proposed establishment of any hydrogenation or other plant for the extraction of oil from coal, and after full consideration is given to our natural advantages, I have no doubt where the plant will be located; namely, in West Virginia.

I would like to present these maps showing where coal is mined in the State. These figures here show the tonnage that is contained in those seams of coal. (Maps on file with the committee.)

Senator O'MAHONEY. You don't have to prove to this committee that there is lots of coal in West Virginia.

Congressman RANDOLPH. Senator, I would like to ask Mr. Tucker just one or two brief questions before you close the morning hearing.

Senator O'MAHONEY. Yes.

Congressman RANDOLPH. Mr. Tucker, you believe that the West Virginia interests, our State government units as well as private industry, would be favorable toward this legislation?

Mr. TUCKER. Undoubtedly.

Congressman RANDOLPH. You believe also that in the program which would be set up under the United States Bureau of Mines, our own school of mines at Morgantown, which is an excellent institution, can join hands with the Federal Government perhaps in carrying on certain experiments at the direction of Dr. Storch and others?

Mr. TUCKER. I think they would be capable of assisting in the work and will be glad to do it.

Congressman RANDOLPH. Dr. Storch, at this point would it be possible or feasible to call into this picture of study and experimentation an institution with laboratory and personnel facilities so close by what you are doing here?

Dr. STORCH. Yes; that would be eminently desirable.

Congressman RANDOLPH. I appreciate that. I think there is a spirit of cooperation among our people on this problem. That is all I have, Mr. Chairman.

Senator O'MAHONEY. Are there any questions, Congressman Kelley?

Congressman KELLEY. No.

Senator O'MAHONEY. Congressman Furlong?

Congressman FURLONG. No, Senator.

Senator O'MAHONEY. Congressman Scanlon?

Congressman SCANLON. No, Senator; nothing.

Senator O'MAHONEY. Senator Murdock?

Senator MURDOCK. No.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No questions.

Senator O'MAHONEY. Is there anything you care to add, Mr. Tucker?

Mr. TUCKER. No; not particularly.

Senator O'MAHONEY. The committee is very grateful to you, sir. We are sorry that you are obliged to leave us this afternoon.

Mr. TUCKER. I want to file these maps with the committee, as they will be helpful to you, I am sure.

Senator O'MAHONEY. Very well.

(The maps referred to were filed with the committee by Mr. Tucker.)

Senator O'MAHONEY. This committee stands adjourned until 2:15 p. m.

(Whereupon, at 12:05 p. m. the committee adjourned until 2:15 p. m. of the same day.)

AFTERNOON SESSION

(Pursuant to adjournment for the noon recess, the committee reconvened at 2:15 p. m.)

Senator O'MAHONEY. The committee will be in order.

The chairman is advised that Mr. Marcus Kerr, chief of the department of mines, State of Ohio, like the geologist of the State of West Virginia, is under obligation to leave almost immediately. The committee is very anxious to hear him. We therefore call him as the first witness, if he will be good enough to come forward.

STATEMENT OF MARCUS KERR, CHIEF, DIVISION OF MINES, COLUMBUS, OHIO

Mr. KERR. Senator O'Mahoney, representing Governor Bricker and the interests of the State, I want to offer you and the committee the heartiest endorsement of this legislation.

Senator O'MAHONEY. Thank you, sir. We are glad to have that statement from Ohio.

Mr. KERR. In the event of its enactment, we also want to offer the State's facilities, of all kinds, in cooperation with the United States Bureau of Mines.

In view of the statements this morning, I won't dwell on the obvious advantage of Ohio's location in this plan but we expect to present some material on that at a more suitable time.

Senator MURDOCK. Will it be difficult to persuade the State of Ohio that Ohio is the proper site?

Mr. KERR. I don't think it will take a great deal of time.

That is all I have to say, Mr. Chairman. I don't want to take up the time of the committee. I merely want to express the State's endorsement.

Senator O'MAHONEY. Mr. Kerr, we will be very glad to have you file a written statement with the committee. This record won't be printed probably until Congress is ready to assemble again in September, and if you care to amplify your statement we will be glad to receive it.

Mr. KERR. Thank you.

Senator O'MAHONEY. Dr. Schroeder, if you will be good enough to take the stand. The committee will now hear a report from one of the two men sent by the Bureau of Mines to Great Britain to check on the hydrogenation of coal in England.

STATEMENT OF W. C. SCHROEDER, ASSISTANT CHIEF, FUELS AND EXPLOSIVES SERVICES, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Senator GURNEY. Doctor, can you tell us the annual output of this plant in England?

Dr. SCHROEDER. The daily output is about 3,500 barrels a day. About 150,000 metric tons a year.

Senator MURDOCK. And how many tons of coal are consumed in the production of that amount?

Dr. SCHROEDER. About 4.5 times one hundred and fifty tons.

Senator MURDOCK. That includes not only the coal that was treated, but the coal used in the production of power?

Dr. SCHROEDER. Yes; everything that goes to make up the process.

Congressman KELLEY. Are they using coal right now at Billingham?

Dr. SCHROEDER. They are using tar because they are trying to get their output for aviation gasoline as high as possible.

Senator O'MAHONEY. What is the source of the tar?

Dr. SCHROEDER. Some of it comes from low-temperature coke ovens and the remainder from high-temperature coke ovens.

Congressman KELLEY. It is the coal-tar product that goes to make the liquid fuel at the Billingham plant?

Dr. SCHROEDER. Right now. They operated from 1935 through 1938 on coal plus tar. Then with the demand during the war, for aviation gasoline, they switched over to tar because they could increase their output of aviation gasoline.

Congressman KELLEY. They could increase the output but could they increase the quality?

Dr. SCHROEDER. No. They can make just as good gasoline from coal as from tar but somewhat less.

Congressman KELLEY. Very much less?

Dr. SCHROEDER. Yes; it cuts their production around a quarter, I believe.

Congressman KELLEY. May I pursue that a little further—about the tar? We have the same grades of coal in the United States—that is, coking coal, used largely today in byproducting coke; and one of the essential elements that we obtain is the coal-tar products from which are derived many of these refined products, many of the thousand that we have come from the coal tar; is that correct?

Dr. SCHROEDER. That is correct.

Congressman KELLEY. Now, if we would take those coals, the by-product coking coals, and take the tar to use for obtaining gasoline, then we would lose, would we not, the other valuable byproducts if we used those particular grades of coal, byproduct coking coal?

Dr. SCHROEDER. I am not sure I see where you are going. We don't propose to use tar in the United States.

Congressman KELLEY. But if we wish to obtain a larger quantity of gasoline, if we could get it by using the coal-tar products rather than the coal itself?

Dr. SCHROEDER. That is correct. Larger quantity of products from a given plant installation.

Congressman KELLEY. That is right.

Dr. SCHROEDER. Although, if we want to save our coal tar, then we can build additional plant capacity and use coal directly.

Congressman KELLEY. I will ask you this directly: Is there such a thing as using the residue of the coal-tar products for gasoline and still obtain the byproducts we do now from the coal-tar products?

Dr. SCHROEDER. By the residue from the tar, do you mean pitch?

Congressman KELLEY. Yes.

Dr. SCHROEDER. Yes; you could hydrogenate pitch. I think, however, it would be better to hydrogenate the coal directly. Isn't that true, Dr. Storch?

Dr. STORCH. It is a matter of how much gasoline you want. If you are talking about supplying the Nation with gasoline, you can't do it by using tar because you haven't got enough tar. You are not making enough tar to supply more than a small fraction of the necessary needs for gasoline.

Congressman KELLEY. What I am interested in is this: In this process we don't need to sacrifice any of the byproducts we get now in the byproduct coking process; we don't need to sacrifice, say there are 1,000 byproducts we get from coal in order to make gasoline now with grades of coal that are not coking; is that right?

Dr. STORCH. That is right.

Congressman KELLEY. That is all.

Senator GURNEY. Dr. Schroeder, you told us that they use about 150,000 metric tons of coal in England per year at this plant, did you not?

Dr. SCHROEDER. No. That is how much gasoline they are making.

Senator GURNEY. How much coal do they use?

Dr. SCHROEDER. About four and one-half times that amount.

Senator GURNEY. With four and one-half times that amount they produce 150,000 metric tons of gasoline per year?

Dr. SCHROEDER. Yes.

Senator GURNEY. And that makes 3,500 barrels per day?

Dr. SCHROEDER. That is right, roughly.

Senator GURNEY. I would like to get it down a little finer. How many metric tons, that is, per working day, so I can see how many gallons or barrels come out of a ton?

Dr. SCHROEDER. There are about 7 barrels in a ton of oil.

Dr. STORCH. You would use 675,000 tons of coal a year or roughly about a little over 2,000 tons of coal a day.

Senator GURNEY. Metric tons?

Dr. STORCH. Yes.

Senator GURNEY. And a metric ton is how much?

Dr. SCHROEDER. Two thousand and two hundred pounds, roughly.

Senator GURNEY. Thank you.

Senator MURDOCK. May I say this, Senator Gurney, that the paper of Dr. Storch shows that 500 tons is the equivalent of 3,500 barrels. That is, as I understand the figures on the paper.

Dr. STORCH. Yes.

Dr. SCHROEDER. That is about right; 7 barrels to the ton, roughly. That depends a little bit on whether you are talking about gasoline or primary products. Gasoline, of course, is lighter than oil.

Senator MURDOCK. May I ask, in line with the questions of Congressman Kelley, Isn't there a large market here in the United States today for smokeless fuel?

Dr. SCHROEDER. Yes; I should think so, particularly as a result of the smoke ordinances and the tendency of the cities to clean up their atmosphere.

Senator MURDOCK. I know the condition in Salt Lake City in winter-time is almost unbearable due to the smoke, and in my contacts with the Bureau of Mines, the War Production Board, and other Gov-

ernment agencies, I have been advised that the problem in Salt Lake is no worse than it is in Pittsburgh and many other cities.

Now, I am wondering, if there is a market for smokeless fuel, why it would not be wise for this country to produce that smokeless fuel for the different cities that have this smoke problem, and then apply your hydrogenation process to the tar which is a residue of that process.

Dr. SCHROEDER. So far as you could get rid of the coke, whether it be low temperature or high temperature, I should think that would be the economic thing to do.

Senator MURDOCK. It seems to me that we should be giving some attention to that question and if we can solve this smoke problem in the United States, in the scores of cities that have that problem, and at the same time demonstrate the commercial feasibility of the production of gasoline from the hydrogenation of tar, it certainly is worth while to consider.

Dr. SCHROEDER. I think that is correct.

Senator MURDOCK. As I understood you, you are giving little attention to that phase of the situation at this time.

Dr. SCHROEDER. I didn't mean to neglect that viewpoint at all. So far as we can provide tar, to hydrogenate that is a much less difficult problem or, at least, somewhat less difficult than the hydrogenation of coal, which is exactly what the English have experienced during this war. From that standpoint, so far as we can get the tar to start with as a raw material, we should use it.

Now, of course, we shouldn't create so much smokeless fuel that we can't use it.

Senator MURDOCK. No; I wouldn't suggest that, but I know that the people of Salt Lake City are clamoring constantly for smokeless fuel.

It was suggested to me here by the chairman, What will the cities do in cooperation with that type of effort? I know what Salt Lake City will do. They would be willing to go to any length in cooperation, I think, financially and otherwise, in the building of a plant which would result in smokeless fuel for that area.

Dr. SCHROEDER. Yes.

Senator MURDOCK. Now, your hydrogenation process would be just as applicable, would it not, to tar as it would be to coal?

Dr. SCHROEDER. Well, if you are going to provide smokeless fuel by a carbonization process, I think the subsequent application of hydrogenation to your tar would give you a much more useful secondary product which would add to the value of your carbonization process. In other words, it would enhance your whole process by yielding gasoline of high quality as a byproduct.

Senator MURDOCK. Now, going back to the situation in England, Mr. Schroeder, you say that the Billingham plant is using tar almost exclusively?

Dr. SCHROEDER. Yes, sir.

Senator MURDOCK. During this emergency?

Dr. SCHROEDER. Yes, sir.

Senator MURDOCK. That would indicate, would it not, that they must have many other plants in England that are producing the tar from coal?

Dr. SCHROEDER. Yes, sir; that is correct. Of course, England has a big steel industry and they can draw on the tar from that industry. Senator MURDOCK. Do they produce a coking coal along with tar?

Dr. SCHROEDER. They produce coke along with the tar.

Senator MURDOCK. Which, of course, is used in the steel industry?

Dr. SCHROEDER. Yes, sir.

Senator O'MAHONEY. Then it would be a good economical method of producing oil and gasoline to produce first smokeless fuel?

Dr. SCHROEDER. Yes, sir, so far as you have a market for your smokeless fuel.

Senator O'MAHONEY. Now then, how much more expensive than ordinary coal would smokeless or briquetted coal be?

Dr. SCHROEDER. What I would say now would be nothing more than a guess.

Senator O'MAHONEY. Well, isn't it true that if any city which is plagued by smoke, wanted to get rid of the smoke, it could do so if it were willing and if people were willing to pay whatever is necessary to bring briquetted coal into the market?

If there were a market in other words, in Salt Lake City, or in Pittsburgh, for briquetted coal, that is to say, for smokeless fuel, the industry could furnish that fuel?

Dr. SCHROEDER. That is correct, industry could furnish a briquetted coal.

Senator O'MAHONEY. So that if any city is plagued by too much smoke, then organized effort in that city to bring about the purchase of briquetted coal or smokeless fuel would result in getting rid of the smoke?

Dr. SCHROEDER. That is correct, but you must bear in mind that you have not only the domestic consumers to consider, but you have the railroads and other industrial consumers to convince.

Senator O'MAHONEY. Yes. That, of course, brings you back to the question of how much more expensive it is to use smokeless fuel.

Dr. SCHROEDER. That would bring you back to your economic situation, yes.

Senator O'MAHONEY. And you have no information on that?

Dr. SCHROEDER. No.

Senator O'MAHONEY. Would it be possible for you to work that up?

Dr. SCHROEDER. I think that could be worked out, yes.

Senator O'MAHONEY. Will you do that and put it in the record?

Dr. SCHROEDER. Yes, sir.¹

Senator MURDOCK. May I suggest here that Mr. L. C. Karrick, formerly an employee of the Bureau of Mines, made this statement at

¹ The following statement was subsequently submitted by Dr. Schroeder:

"STATEMENT ON COST OF BRIQUETTING AND CARBONIZATION

"Briquetting costs are estimated to vary from \$1.50 to \$3 per ton of coal. The type of coal, the briquetting process, the binder, the size of the plant, and many other factors influence this cost.

"Estimates for the cost of low- or high-temperature carbonization to produce a smokeless fuel are complicated because the byproducts such as manufactured gas, oils, and tar are valuable. The size and degree of mechanization of the plant, the coal user and the details of the process enter into this cost. Total costs for high- or low-temperature carbonization are estimated between \$1.50 and \$2.50 per ton of coal carbonized, excluding allowance for byproducts. In many cases, this credit will defray a major portion of the carbonization costs. On the other hand, the weight of coke obtained from the process is less, by as much as 20 to 40 percent, than the weight of coal fed to it, and the cost of the product reflects this difference."

a former hearing of this committee at Salt Lake City, reading from page 770 of part I of the printed record:

Therefore, these coals, where there is a market for the smokeless fuel and the gas, can produce oil cheaper today, on an average, cheaper than the average cost of the well petroleum in the western part of the United States.

That is the statement made by Mr. Karrick.

Dr. SCHROEDER. The thought occurs to me that if that actually is true and the oil is a valuable product, I am surprised that somebody isn't doing it on a fairly large scale.

Senator GURNEY. Could you tell us, Dr. Schroeder, how that coal they are using in England compares with any coal in this country, have we got any like coal here?

Dr. SCHROEDER. I think it is a high volatile bituminous coal, containing around 30 percent volatile matter.

Is that about correct, Dr. Storch?

Dr. STORCH. It is my understanding that the coal being used at Billingham is almost identical with the Pittsburgh steam coal, both in composition and general properties.

Dr. SCHROEDER. Dr. Storch might like to mention in that connection that they have a very serious sludge problem at Billingham, which is one of the problems which is unsolved in connection with using bituminous coal. They use a good cleaning process which brings the ash down to about 2½ percent.

Congressman KELLEY. It is comparable to the Pittsburgh coal in that respect?

Dr. SCHROEDER. Yes, it is very similar to it.

Senator O'MAHONEY. What do the British coal reserves amount to now? Do you know?

Dr. SCHROEDER. No, I don't know what their reserves are, but one of the chief difficulties with the British operation of this process is relatively high mining cost. Their miners only produce about half or a third as much coal per man-day as we do in American mines.

Senator O'MAHONEY. Is that by reason of the greater depth in mining?

Dr. SCHROEDER. A number of reasons enter into it. Relatively thin seams, older mining methods, less mechanization.

Senator O'MAHONEY. Coal has been mined in England and in Wales for a long time.

Dr. SCHROEDER. Yes.

Senator O'MAHONEY. Is there any possibility that the reserves there are being exhausted now?

Dr. SCHROEDER. No. I think that their reserves are quite adequate. They are somewhat worried about their reserves of good coking coal, but their reserves as a whole are ample at the present time.

Senator O'MAHONEY. Are there any other questions?

Mr. MAIZE. Mr. Chairman, may I supply some information at this point?

Senator O'MAHONEY. Yes indeed, Mr. Maize.

Mr. MAIZE. I have had occasion to look this up recently, and the statement I received from Great Britain was that there was 250,000,000,000 tons of reserve coal in Great Britain.

Senator O'MAHONEY. Two hundred and fifty billion?

Mr. MAIZE. Two hundred and fifty billion.

Senator O'MAHONEY. Well, then Great Britain is not likely to run out of fuel sources in some time, is it?

Mr. MAIZE. That is right.

Congressman KELLEY. You say that the coal used at the Billingham plant in England was comparable to the Pittsburgh coal—that is, their coking coal?

Dr. STORCH. That is right.

Congressman KELLEY. Then they are using that instead of carbonizing?

Dr. STORCH. That is correct.

Congressman KELLEY. Pursuing the same thought I had a while ago, we don't need to use a high coking quality coal in this country for the hydrogenation to obtain motor fuel, we can use the other coal, steam coals, the lower grade coals for that purpose, and not use the coking coals?

Senator O'MAHONEY. Precisely. I think that is the general feeling.

Congressman KELLEY. Senator Murdock brought up the question, or pursued the question, before, about using coal tar for the production of motor fuel. Dr. Storch, here a moment ago, said we couldn't produce enough coal tar to do that in this country to get enough gasoline.

Dr. SCHROEDER. I don't think, when Dr. Storch said that, that he was thinking particularly about the domestic market, a large domestic market for a smokeless coal.

Dr. STORCH. Even if you invested in large-scale smokeless fuel development, the tar that would be available would probably be not very much greater than corresponds to 10 percent of our gasoline consumption in this country, because, after all, you are not going to provide smokeless fuel for every city in the country, but you probably will have provision for those cities that are plagued by it.

Senator O'MAHONEY. You can make smokeless fuel without touching the coking coal, is that right?

Dr. STORCH. Yes.

Congressman KELLEY. But they can make smokeless fuel by coke in the carbonization process, either low temperature or high temperature?

Senator O'MAHONEY. The situation is simply this: In Utah there are substantial deposits of coking coal. In Wyoming, which is separated only by a hypothetical line, there are practically no deposits of coking coal.

The steel industry, which prefers to operate by the blast furnace method, needs coking coal, and therefore the war effort has brought about the development of the steel industry in Utah, but not in Wyoming, because of the presence of coking coal in Utah.

Therefore, the question occurred to me, if coking coal is required for the steel industry, it might be to the public interest not to use the coking coal for the purpose of developing smokeless fuel, but to use those other coals which are not capable of producing coke.

Have you finished your statement, Dr. Schroeder?

Congressman KELLEY. I would like to ask another question, if I may.

Senator O'MAHONEY. Yes, indeed, Congressman.

Congressman KELLEY. Can you give us any idea as to the performance, the efficiency performance of gasoline obtained from coal as compared with that obtained from petroleum?

In other words, have you tried this gasoline from this experimental station?

Senator O'MAHONEY. Before you answer, Dr. Schroeder, may I say for the benefit of the record that when we left this building at noon today we drove to the Duquesne Club in automobiles that were fueled by gasoline made in this plant. I had the privilege of driving one of these cars and there wasn't a sputter in the engine, as Congressman Kelley knows, from here to the Duquesne Club.

I didn't know the difference. If it hadn't been for the fact that this gasoline made from coal was being fed from a glass jar on the hood, we wouldn't have known that we were driving with hydrogenated gasoline.

In Washington where our first hearings were held, in the committee room, there was an engine which was supplied by two reservoirs of gasoline which could be interchangeably thrown to the carburetor. One was a reservoir of ordinary gas and the other was a reservoir of the Bureau of Mines Pittsburgh gas made from coal, and it was altogether impossible to determine, except by sight, when that engine was running on the hydrogenated gasoline and when it was running on petroleum gas.

Dr. SCHROEDER. I think, if you subjected the gasolines to the most critical examination, that the gasoline produced by coal hydrogenation could be made to do everything that the gasoline produced from petroleum can do.

Congressman KELLEY. I thought you would get more miles per gallon of gasoline from the synthetic gas.

Dr. SCHROEDER. I think that would be fine if we could, but I don't believe it is true.

Congressman RANDOLPH. May I follow through on the subject matter that Senator O'Mahoney has just spoken of as to the quality of the fuel itself.

Is it not a fact, Dr. Schroeder, that aviation authorities in Great Britain testing motor fuels which have been manufactured by both the Bergius and the Fischer-Tropsch processes, found that the Bergius motor fuel gave a better account of itself?

Dr. STORCH. As I understood your question, it was whether there was a difference in the qualities of gasoline as produced by the Bergius and as produced by the Fischer-Tropsch process?

Congressman RANDOLPH. That is right.

Dr. STORCH. The answer is that there is a very great difference. The Bergius process produces a very high quality antiknock motor fuel. The Fischer-Tropsch process produces a very poor quality motor fuel which must be processed extensively before it can be upgraded to the level of the Bergius.

Congressman RANDOLPH. Then the aviation gasoline being used in the present conflict has been built, on the synthetic side, on the Bergius process, rather than the Fischer-Tropsch, is that correct?

Dr. STORCH. That is correct.

There is aviation fuel being made in Baton Rouge and at Billingham, England, which is the highest quality aviation fuel available today and in both plants the high-pressure hydrogenation is the im-

portant part of the process. In Baton Rouge it is the high-pressure hydrogenation of petroleum oil and in Billingham, it is the high pressure hydrogenation of tar oils. But they both yield a very high quality aviation fuel.

Senator O'MAHONEY. If we are to hear all the 10 witnesses whose names appear on the list before me, I think we will have to proceed now with a little more expedition. Dr. Schroeder, I think your statement at this time has been completed.

Dr. SCHROEDER. Yes.

Senator O'MAHONEY. We are very grateful to you for your contribution.

(A supplemental statement by Dr. Schroeder is as follows:)

CONVERSION OF COAL TO OIL

Conversion of coal to oil often appears to be a complicated and mysterious process. Nevertheless, the two substances in the natural state have certain high degrees of similarity. For example, oil can be broken down into its main constituents, which are about as follows:

	Percent
Carbon	85
Hydrogen	13
Sulfur and nitrogen	2

Similarly certain bituminous coals, after being freed from ash, might be represented as—

	Percent
Carbon	83
Hydrogen	7
Sulfur and nitrogen	3
Oxygen	7

Both coal and oil have about the same amount of carbon, sulfur, and nitrogen. On the other hand, the oil contains little oxygen and about twice as much hydrogen as coal. In the simplest terms, to convert coal to oil the oxygen in coal must be removed (or reduced) and the amount of hydrogen increased. In this case the proverbial killing of two birds with one stone is not only possible but the best way to do the job. In brief, the coal and hydrogen will be put together and first the hydrogen and oxygen unites to form water in accordance with the familiar formula H_2O ; next, more hydrogen is supplied until 13 percent is reached, and the mixture becomes oil. Unfortunately, however, when you simply put coal and hydrogen together you don't get oil.

At this stage, the chemists lost all interest in getting oil and began to test the idea of getting the oxygen out of coal and more hydrogen in—let the product be whatever it wanted to be. Since hydrogen is a gas and coal is solid, one of the first obvious steps was to try to force the gas into place by making the pressure higher and higher. This apparently was on the right track, for even today they are pushing the gas into the coal with pressures up to 10,000 pounds per square inch. But pressure alone wasn't the whole story, so the coal and hydrogen were heated and cooled with high- and low-hydrogen pressures until finally a small yield of oil was secured.

Even the chemist wasn't satisfied with the result, but what else could be done? Frequently, when a chemist reaches this state of affairs he adds various chemicals from the bottles on his shelf, in the hope that some good will come of it. If this happy result is achieved, the good material may be called a "catalyst" and is said to promote the reaction. Tin, molybdenum, and a few other metals acted as catalysts in the presence of coal and hydrogen at high pressures and fairly high temperatures, to yield an end product something like oil.

A few countries with lots of coal and no oil quickly realized that this process might be developed to make them independent of imported oil in time of peace or war. Particularly in Germany, the whole program was put under forced draft to translate the test-tube process into commercial production of gasoline and oil. The British people saw its importance later than the Germans but even in 1932 they were working on the design of a full-sized plant. I had an opportunity to thoroughly examine this achievement of science when I was sent to England

this spring by the Bureau of Mines. It is difficult to describe in words the engineering embodiment of this simple idea that coal could be converted to oil. Through the kindness of Imperial Chemical Industries and under the direction of Major K. Gordon, who has been closely identified with this development since its inception, we were given the assistance of five or six engineers to help us secure both the broad and detailed information that we could in the time available.

The first few days we spent in discussion and study of the plant lay-out. When we went into the plant itself, I suppose I inevitably carried a mental picture of the small laboratory set-up operated by the Bureau of Mines in Pittsburgh, which is all in one building, with small compressors and pumps and towers only about 10 feet high, in which the coal is converted to oil. I was astonished at the size of the Billingham plant in spite of all I had previously read about it. It covers an area of many acres with the converter towers standing 70 feet high and with a network of pipe lines making connections to the auxiliary units. The size of this development, the hard and intense physical and mental effort that has gone into building it up, as well as the clear picture that was developing in England regarding synthetic liquid fuels, made one realize how far the United States was falling behind in this field. Our work at the Bureau of Mines has never been financed on a scale that would allow us to approach the problems on anything resembling a comparable scale.

The plant starts in one side with coal (which is washed until the ash is very low) and on the other side with hydrogen gas. The coal is run through various mills and mixed with enough tar and oil to form a paste so that it can be pumped through high pressure hydraulically operated pumps, along with the hydrogen gas, into huge converter towers. The coal and oil react at first to form a heavy oil, which is passed through more towers with more hydrogen until ultimately out of the plant pour only gasoline, oil, and a little pitch. One of the strange and valuable features of this process is that it can be operated in a variety of ways to produce only high-octane gasoline and pitch, or gasoline, oil, and pitch, or again gasoline, oil, toluene (for explosives), gasses (for raw materials for rubber), and pitch.

An interesting feature of the plant is the fact that the engineers who built it feel that bombing would do relatively little damage except for a direct hit on some vital piece of equipment. The converters, auxiliary equipment, pipe lines, etc., are all so heavily constructed to withstand the great gas pressure that they could be severely damaged only by a direct hit. This one plant provides Great Britain with enough fuel to send a fleet of bombers over Germany every night.

The converters at this plant are so large that some wonder exists as to what, if any, limitations are imposed on their size. By using all the metal which their steel companies can provide in one ingot, a converter can be forged. Presumably, if larger ingots can be made, the size of the converters could be increased. As a matter of fact, American engineers have developed methods which can be adapted to making larger converters. This would be a material advance and would help to reduce the entire cost of the plant per unit of output.

The Billingham plant represents one of the embodiments of the dream of converting coal to oil. Certainly it is not the final word, and further research and development will see improvements. If the United States is to supplement what appears to be a diminishing petroleum supply by making oil from coal, our studies on this process should be started immediately.

FROM COAL TO GAS TO OIL

The difficulties encountered by the chemical and mechanical engineers in the simple operation of bringing coal and hydrogen together under very high pressure surprised the chemist. There must be some simple way to do the job.

The trouble was apparent. If these engineers only needed to handle gases and not solids, their problem would be simplified. To get rid of the solid, the coal could be burned, or, better still, half burned, to secure a very reactive carbon monoxide gas. Fortunately if this coal is burned in an atmosphere of steam it will release hydrogen about as follows:



Here the coal is changed completely to the gaseous state.

But how does this help to make oil? It looks as if the process goes from solid to gas and skips completely across the liquid state. However, it is pos-

sible to string these carbon monoxide molecules back together, with the hydrogen to produce oil.

Thus started the search to get the right temperature, the right pressure, and when these were found to be only partly successful, the right catalyst to put molecules of carbon monoxide and hydrogen gases together to get liquid but not too much solid. This process was finally made to work. By breaking the coal down almost completely and putting it back together again with more hydrogen the final product was oil. Even more fortunately, the entire process can be carried out at very low pressures. Now the chemist really had a process to give to the engineers, and this time the equipment did prove to be relatively simple. By this synthetic process, high- or low-ash coal can be used and after it has been partly burned to carbon monoxide in the presence of steam, the outgoing gases are so treated that they give a mixture containing 1 part of carbon monoxide and 2 parts of hydrogen. These gases are, then, the raw material from which the oil is made, and the next step in the operation is again simple—the gases are passed over a catalyst under the proper conditions and the result is gasoline, oil, and some wax.

The process appears almost without fault. This is not quite true, however, for when the gases combine to form oil, a large amount of heat is released which tends to make the temperature run away so that control of the process is lost. This has forced the engineer to design the equipment on a large scale and provide ample amounts of cooling water. However, in these respects it is susceptible to major engineering modification that can bring about great improvement.

Unfortunately, the United States and Great Britain have let Germany, and to some extent Japan, take the lead in developing this method. In Germany, plants using this process are furnishing a material proportion of gasoline, Diesel oil, and lubricating oil. The Government in Great Britain is giving the method serious consideration and is ready to go into large-scale development as soon as material is available. During my visit to England, many people expressed the opinion that development work could wait no longer, and if this opinion gains strength, the British may go into the process at once.

The scientific and engineering groups in Great Britain are well acquainted with the German development up to 1939 or 1940. Their engineers were making frequent visits, sometimes even monthly visits, to the German plants up to the time the war began. In London, there are also a number of scientists who have worked on this process and have been connected with its development in Germany and who have been forced to leave that country since Hitler came into power. This situation gives the British an excellent background from which to start their work.

In the United States, information concerning methods for making oil from gases is less comprehensive. One of the purposes of the visit Dr. Storch and I made to Great Britain was to amplify our information on this and other processes for making synthetic liquid fuels.

Through the kindness of the British Government and industry, complete information was given to us on the status of all their synthetic liquid fuel work. We visited the Fuel Research Station, National Physical Laboratory, Scottish Oil and Shales (Ltd.), Imperial Chemical Industries, Powell Duffryn Associated Collieries, and other organizations and individuals.

Just outside of Edinburgh, Scottish Oil Shales (Ltd.) is producing large quantities of oil daily from shale. We went through the entire plant with Mr. Robert Crichton, the managing director; starting with the mining of the shale 700 feet underground, crushing, retorting—where the oil is driven out by heat—and finally through the refining plant, where the oil is separated into gasoline, Diesel oil, fuel oil, and wax. This plant has greatly improved its products as well as methods for handling shale during the past few years. A whole battery of modern retorts was completed in 1941 which handle shale much more rapidly than the old ones. Advances in oil refining have permitted greater yields of good gasoline and Diesel oil.

The United States has very large amounts of oil shale, particularly in a number of Western States; some of these shales are much richer in oil than the Scottish shales, while others contain about the same amount. Our mining costs would probably be much lower than the costs in Scotland, since the shale is closer to the surface and some of it can be stripped out with steam shovels. At present, this material is not used for any purpose, and it would furnish an ideal raw material to supplement petroleum. The country should start at once to con-

struct demonstration plants to solve the economic and engineering problem connected with the utilization of shale under American conditions.

The Billingham coal-hydrogenation plant and the oil shale plants in Scotland represent the largest synthetic fuel developments in Great Britain. Other ways of producing synthetic fuel are being intensively studied, some on a semicommercial scale. All of these laboratories and plants were visited. The information secured furnishes both a broad and detailed background for development work in the United States.

SYNTHETIC FUELS IN GREAT BRITAIN AND THE UNITED STATES

The British interest in the production of synthetic liquid fuels naturally results from the lack of petroleum in the British Isles in contrast to relatively large supplies of coal. In the United States we have an abundance of coal but also have had ample supplies of petroleum. As a result of this fortunate condition the petroleum industry in the past has been able to devote its undivided attention to the perfection of its product for a wide variety of uses. Development runs from the application of simple cracking processes to anti-knock compounds, re-forming and alkylation processes to the most modern fluid catalytic cracking methods. Not only have gasoline and oil improved but the refineries have grown to be the source of raw materials for a host of industries.

On the other hand, Great Britain and many foreign countries without petroleum have devoted their efforts to making oil from raw material that they do have. They are making long strides in the hydrogenation and gas synthesis processes, and their experience indicates not only the great importance of this work with respect to liquid fuels but also a source of raw materials for the synthetic rubber, plastics, and explosives industries. Full realization of the tremendous potentialities inherent in these developments exists in many circles in Great Britain and doubtless in Germany. These hearings should help to make them clear to the people of the United States.

The history of the scientific work in the United States shows repeated instances of our failure to carry on investigation in important engineering and chemical fields, either because of the feeling that we could import the material we needed or because there was no apparent profit in undertaking the work. There are several outstanding examples of this failure to anticipate our needs. One was the lack of chemical industry in this country during the last war. We had depended heavily on Germany for chemicals, explosives, dyes, and drugs and had neglected to develop our own industry. The war of 1914-18 proved this to be a very poor policy. We struggled violently to build up an industry quickly. Ever since, however, United States has been a leader in the chemical field. Certainly we would have been relieved of a difficult time if we had bent our efforts to developing a chemical industry long before that war started.

At the outbreak of the present war, we suffered sharply because we had not adequately developed our optical industry, and we are still struggling to make up many deficiencies. Although much of the early laboratory work on synthetic rubber had been done in this country, when our supply of rubber was cut off it was soon evident that we were badly prepared to establish a rubber industry on a commercial scale.

The United States is now in the test-tube stage of development in the methods of producing synthetic liquid fuels. Bill S. 1243, introduced by Senator O'Mahoney, shows the way to reap the benefit from this research by building demonstration plants which will furnish the basic knowledge for subsequent expansion on any scale necessary.

A whole new field of chemistry and chemical engineering is now opening up, and our scientists and engineers should be leaders in the work. Seldom do the annals of technology offer an opportunity of this magnitude. We will not be left standing by the road if the provisions of Senate bill 1243 are followed.

Senator O'MAHONEY. Is Mr. Eugene Ayres present?

Mr. AYRES. Yes.

Senator O'MAHONEY. Mr. Ayres, you are to speak on behalf of Mr. Paul D. Foote of the Gulf Research & Development Co. You may proceed.

STATEMENT OF EUGENE AYRES, STAFF CHEMIST, GULF
RESEARCH & DEVELOPMENT CO., PITTSBURGH, PA.

Mr. AYRES. Senators, my statement is very brief indeed.

My name is Eugene Ayres. I am a chemical engineer by profession, and in the last 14 years I have served in various capacities in the Gulf Oil Corporation and the Gulf Research & Development Co. From 1929 to 1934 I was in charge of hydrogenation research for the Gulf Oil Corporation, and since that time I have been staff chemist of the Gulf Research & Development Co. in charge of process development. We have been active in the study of the various processes for the production of liquid fuels from coal and gas.

I appreciate this opportunity to comment upon bill S. 1243, because the development of supplemental sources for liquid fuels within this country is of importance to our national welfare and is of particular importance to the petroleum industry.

It is my opinion that the Bureau of Mines with its distinguished personnel is eminently fitted to carry out the task proposed for it, but no single Government or private agency, no matter how competent, can achieve the maximum of progress without the wholehearted assistance of all of the technical talent of the country. I am, therefore, gratified to note that the bill calls for cooperation "with any private person, firm, or corporation in effectuating the purpose of this act."

I would like to emphasize the fact that the Fischer and hydrogenation processes are in their infancy. It is true that because of military necessity many commercial plants employing these processes have been built and put in operation abroad, but these plants cannot be regarded as commercial, in an economic sense, for the United States.

A long road of research and development must be traveled. It is certain that the successful commercial plant of the future will bear very little resemblance to the pilot plants that can be designed at this time—and still less resemblance to the operating plants abroad.

It would seem wise, therefore, to regard the first pilot plants as representing only tentative principles and to make them as small and as inexpensive as the collective judgment of Government experts and the experts of industry may consider expedient. Each of the many pilot plants built by Government and by private industry will represent a step in the orderly progression of research.

It seems to me that it is of the utmost importance for the petroleum industry and the coal processing industry to do whatever they can to contribute to the success of the Bureau of Mines in this undertaking.

So much statistical, economic, and technical material has already been presented to this committee that I shall limit myself to this brief statement. However, I shall be happy to try to answer any questions.

Senator O'MAHONEY. Mr. Ayres, as I listened to your testimony, the thought occurred to me whether or not, in your opinion, these large private companies which are engaged in the production and refining and distribution of oil, could, by any possibility, cooperate with the Government in the testing of these new processes?

Mr. AYRES. I should think that would be very desirable and very necessary. Various industries have a background of engineering;

that is, not only the petroleum industry but the coal processing industry, have this background of chemical engineering construction experience on parallel operating problems that should make such co-operation, I think, very desirable.

Senator O'MAHONEY. Now, you speak for the research bureau, so to speak, of the Gulf Co., do you not?

Mr. AYRES. That is correct.

Senator O'MAHONEY. That research bureau over a long period of years has been engaged in scientific examination of possibilities for improving the production and refining of oil, has it not?

Mr. AYRES. Yes, sir.

Senator O'MAHONEY. And the work therefore, has been pointed toward the future rather than to the present?

Mr. AYRES. That is true.

Senator O'MAHONEY. In other words, your company and numerous other companies which are likewise engaged in research have been endeavoring to exploit the scientific possibilities of further expansion of the development of natural gas?

Mr. AYRES. That is true.

Senator O'MAHONEY. So that your work is the same kind which is being carried on by the Bureau of Mines except that yours is done under the particular direction of a corporation, while the Bureau of Mines' is being done for the people of the United States as a whole?

Mr. AYRES. Yes, sir.

Senator O'MAHONEY. Have you given any consideration as to the method by which the cooperation between large private companies, such as the Gulf, and the Government could be carried on?

Mr. AYRES. I have given a good deal of thought to that but I would rather not outline anything of that sort at this time. It seems to me it is so important that it requires the greatest possible consideration by all concerned.

I feel that it is something that should be studied and put into effect in the most effective possible way.

Senator O'MAHONEY. I will say to you that this committee would be very grateful for any suggestions that you might be able to make in the future with respect to that question.

Mr. AYRES. I will be very happy to do that.

I would like to emphasize just a little more this point, that any money that is appropriated for this purpose, it seems to me can be more valuable to the country if the greatest emphasis is placed on the research and development aspect of it, rather than the building of any plant that is too large for that purpose.

Now, I am not criticizing plans that have been proposed because I haven't studied them, but I do think that one point should be considered very carefully.

Senator O'MAHONEY. Well, the committee would be very happy to have you take a copy of the bill, and although I say this to you personally, I say it also to all who may be interested, any suggestions for the improvement or the amendment of this measure would be given the utmost consideration by the committee. The sponsor of the bill is not thinking of establishing a Government plant which will compete with private industry.

Mr. AYRES. I didn't have that in mind, Senator.

Senator O'MAHONEY. I will say frankly that I believe the future of this country depends on the degree to which all people can be permitted to participate in the economic, the industrial, the scientific, and the cultural life of the Nation.

Mr. AYRES. I agree with you absolutely on that, Senator, and I have no suggestion to make with respect to the bill itself.

It seems to me the bill covers the situation adequately. But under the bill it is possible to go in a good many different directions. It is possible to emphasize one thing rather than another.

Senator O'MAHONEY. Yes, sir.

Mr. AYRES. My only point is, I hope that the Bureau of Mines will emphasize the research aspect of it particularly because I think that is what is needed in the future.

Senator O'MAHONEY. I will state to you, this committee, and all committees of Congress, when they hold public hearings of this kind, are also engaged in a certain type of research, they are endeavoring to find out what the public mind is thinking about as to problems of this kind, because, after all, any country which is governed by the people is governed by public opinion; so that these hearings are advantageous in that they afford the opportunity for popular knowledge and popular discussion of problems which are under consideration.

I will hand you a copy of the bill, Mr. Ayres, and if you feel you want to make any further recommendations to the committee, by memorandum or otherwise, we will be very glad to hear from you.

Now, I think Senator Gurney would like to ask a question.

Senator GURNEY. Mr. Ayres, I don't know whether you are ready to make any suggestions, but if you can, will you tell the committee what size plant should be built, in the matter of tons of coal per day that should be processed, or gallons produced, that would be necessary for an experimental plant to get the desired result?

Mr. AYRES. I wouldn't presume to make any suggestions of that sort because I am not nearly as familiar with the problem of hydrogenation of coal as the Bureau of Mines, but I would expect that \$50,000,000, for example, spent on one plant would yield less information than \$50,000,000 spent on a great many plants representing many different ideas, many different combinations of processes.

For example, it is possible that the trend in the future, the more economic trend, may be not the hydrogenation of sub-bituminous coal, but rather the carbonization of that coal, followed not only by the hydrogenation of tar, but by the Fischer-Tropsch process on the coke produced.

Now, that is a possibility. I wouldn't predict that it would be the ultimate solution, but there are so many different directions the thing can go that I would like very much to see any money that is appropriated, cover as much territory as possible, considering that all of the territory is exploratory.

It is quite unlikely that any plant that could be built at this time will fail to be obsolete before the end of its operating life.

Senator GURNEY. You feel then we should not build too large a plant, but rather a lot of smaller ones working on different phases of the problem?

Mr. AYRES. That is right.

Senator GURNEY. The 3,500-barrel-per-day plant wouldn't disturb the economics of the oil industry at all?

Mr. AYRES. No; not at all. It is a case of getting the maximum information for the future.

Senator GURNEY. That is all.

Senator O'MAHONEY. Congressman Randolph?

Congressman RANDOLPH. Mr. Ayres, as a representative of one of the units of our oil industry, do you feel that there is any sentiment among your groups that this is competitive with the oil-producing industry?

Mr. AYRES. I have heard no such sentiment expressed.

Congressman RANDOLPH. You believe that your statement would be taken as the viewpoint of the industry as a whole, do you?

Mr. AYRES. As far as I can tell, it is. I don't know, of course, but I haven't heard any such sentiment expressed. The petroleum industry, I think, is quite as anxious as any other industry, perhaps more so, to see that everything is done that can be done to solve this problem for the future.

Congressman RANDOLPH. Most of the leaders of the petroleum industry you would say are in agreement with the general feeling of those who have studied the problem, that our oil reserves are being depleted rapidly?

Mr. AYRES. I believe so.

Congressman RANDOLPH. It varies as to the number of years, but essentially, as to the rate of decrease, there is agreement; isn't that true?

Mr. AYRES. I believe so.

Congressman RANDOLPH. That is all.

Senator O'MAHONEY. Senator Murdock?

Senator MURDOCK. No questions.

Senator O'MAHONEY. Congressman Kelley?

Congressman KELLEY. No questions.

Senator O'MAHONEY. Mr. Ayres, may I ask you, before you retire, whether you have given any personal study to oil shale or natural gas?

Mr. AYRES. Yes; we have given consideration to that, and we feel that both should receive attention under this bill. The Fischer-Tropsch process as applied both to gas and coal is a very simple step, and should receive attention. The matter of shale oil, I think that is a very important one that should be studied. We are studying all of these things, but we think that everybody should be studying them.

Senator O'MAHONEY. Do you feel, as some of those who have spoken to this committee feel, that natural gas can be put to a better use than to be hydrogenated into gasoline?

Mr. AYRES. I am not sure of that. I would like to see some figures on that. Natural gas at the present time is being used as fuel for the manufacture of synthetic rubber, where the fuel requirements are extraordinarily great per barrel of product, 20 times as great as in a refinery.

Well, that doesn't represent an economic use of natural gas. The carbon black industry we know is very wasteful. The conversion of gas to petroleum would probably be, in my opinion, a better utilization of gas than the bulk of the utilization at the present time.

Senator O'MAHONEY. Are there any other questions?

(No response.)

Senator O'MAHONEY. Thank you very much, Mr. Ayres; we are very much obligated to you.

Mr. J. P. Williams, Jr., president of the Koppers Co. is, our next witness.

**STATEMENT OF J. P. WILLIAMS, JR., PRESIDENT, KOPPERS CO.,
PITTSBURGH, PA.**

Senator O'MAHONEY. You may proceed, Mr. Williams.

Mr. WILLIAMS. Senators, as you know, the Koppers Co. is a large builder of byproduct coke ovens and operates a great number of ovens of its own; the company also distills coal tar in a large way, obtaining various products from it. We are also large miners of coal and are greatly interested in this research.

We maintain a large research organization of our own which, for many years, has been more or less in touch with the Bergius and Fischer-Tropsch processes.

Prior to the war, some of our men were in Europe practically every year, keeping in touch with the progress of the art over there.

We have prepared a statement which we would like to file with you; it consists of some 21 pages, I think, and if you would like to have it read, I would like to have vice president, Mr. Denig, read it. He is vice president in charge of research and is much more competent to answer any questions than I.

We would like to cooperate with the Bureau in any way possible in research work, as well as in the development of this plant. We think it is a practical plan for the Government.

Senator O'MAHONEY. Thank you very much. We will be very glad to have Mr. Denig appear, and I am sure he can summarize this 21 pages for us.

Congressman RANDOLPH. I wonder if I might ask Mr. Williams one question?

Senator O'MAHONEY. Yes, indeed.

Congressman RANDOLPH. It goes to the larger aspects, rather than to the technical side.

We have had a representative of the oil industry say that their groups were interested in the experimental program, hydrogenation of coal. What is the feeling of the coal industry, as you understand it?

Mr. WILLIAMS. I think that the coal industry is very much interested in it, although I think the amount of research work done in the coal industry is relatively small, due to the fact, as you know, Congressman, that individual coal companies are relatively small.

Congressman RANDOLPH. Yes, sir.

Mr. WILLIAMS. I believe we are the largest producers of coal in the country outside of the Steel Corporation, and still we produce less than 3 percent of the national production.

Congressman RANDOLPH. You haven't had the money to do it to start with.

Mr. WILLIAMS. No, sir.

Congressman RANDOLPH. We certainly know that.

Mr. WILLIAMS. Yes.

Congressman RANDOLPH. I remember last year, in testimony on this subject, it was charged that the coal industry had lagged behind, and there was a feeling that you had not been alert. I think that was counteracted later by witnesses who said what you have, that the coal industry has not been in a position to go into this phase of it.

Mr. WILLIAMS. That is right.

Congressman RANDOLPH. Then you would look with favor on this proposal?

Mr. WILLIAMS. Yes, sir.

Congressman RANDOLPH. That is all.

Senator O'MAHONEY. Mr. Denig, the committee will be glad to print your full statement as part of the record. Perhaps it will be possible for you to rather generally summarize it for us and answer questions that may be proposed.

You may give your name for the record.

STATEMENT OF FRED DENIG, VICE PRESIDENT IN CHARGE OF RESEARCH, KOPPERS CO., PITTSBURGH, PA.

Mr. DENIG. Mr. Chairman, I think that I can cut this statement down to about one-third, inasmuch as the figures are set up in it for your consideration at your leisure. I would like to read the first several pages and then skip some material and get to the meat of the report.

Senator O'MAHONEY. Very well. You are Director of Research; isn't that true?

Mr. DENIG. Yes, sir.

Senator O'MAHONEY. You may proceed, Mr. Denig.

Mr. DENIG (reading) :

Byproduct coking produces liquid fuels from coals: This year the byproduct coke industry celebrates the fiftieth anniversary of its birth in the United States. The first such plant was built in this country during 1893 at Syracuse, N. Y., for producing ammonia required for manufacturing soda ash. That plant was not initially equipped to recover light oil, but coal tar was obtained as one of the primary liquid products.

Most coal tar is now distilled to produce raw materials required for end products such as plastics, dyestuffs, disinfectants, and medicinals. Hundreds of millions of gallons of coal tar and residual coal tar are burned each year as liquid fuel, principally in open-hearth furnaces at steelworks. Thus liquid fuels made from coal have been produced commercially in the United States annually since 1893. Coal oil (kerosene) for the lamps of China was in fact originally made from coal.

Light oil is obtained as another primary liquid product by coking selected bituminous coals. It is refined into these three principal products—benzene, toluene, and xylenes. Everyone today knows that toluene is the base for the military explosive TNT. A recent important use for one of the xylenes is in the manufacture of synthetic vitamin B₂. While large amounts of benzene are now required for styrene for synthetic rubber, it is probable that the largest present demand for benzene is in manufacturing cumene which is needed in the production of 100-octane aviation gasoline. Thus, today the byproduct coke plants of the country are vital producers of liquid fuels from coal; not only for steel but also for the fighting planes of the Allied Nations.

The byproduct coke industry is indeed a basic key industry serving agriculture and all industries requiring such raw materials as iron, steel, fertilizers, manufactured gas, and numerous organic chemicals having almost infinite applications. It is not an exaggeration to state that modern civilization today depends on coal, coke, and petroleum for its very existence and preservation. In the foreseeable future our industrial and cultural progress may be placed

fundamentally by our as yet imperfect knowledge about coal and its efficient utilization.

* * * * *

Important methods for assuring future supplies of oil: These five methods for assuring our future supplies of petroleum merit careful consideration at this time:

1. Husband our present resources (and other reserves still to be discovered) by restricting the use of natural petroleum, and by substituting lower-grade and more abundant fuels as far as is possible;

2. Augment the supply of our indigenous petroleum by distilling or retorting the oil shale;

3. Manufacture liquid fuels for internal-combustion engines from replaceable sources, such as agricultural products;

4. Adopt and improve known procedures for using solid fuels for internal combustion engines; and

5. Develop processes for producing synthetic oils from other natural resources such as coal, the supply of which—although not inexhaustible—is so enormous as to cause no concern for many centuries to come.

Using oil as low-grade fuel should be discouraged: During the years just prior to the outbreak of this World War, about 500,000,000 barrels a year, or 43 percent by volume of our new supply of domestic crude oil were used in the United States as motor fuel. About 450,000,000 barrels a year, or 38 percent of the entire new domestic supply, were consumed annually as fuel for purposes other than in automotive vehicles. Much of it was used, and is still being consumed, as fuel for house-heating. A large percentage of this consumption, however, perhaps nearly half of it, or about 200,000,000 barrels of oil per year, was burned as low-grade fuel, principally for raising steam on land, not on ships.

Such economic wastage of potentially high-grade fuel for low-grade purposes greatly accelerates the decline of our petroleum reserves. By modern refinery technique much of this oil could have been, and in the future should be, diverted to the production of gasoline, thereby reducing the national requirements for crude oil. Advances in the art of burning solid fuels also make such a saving possible and practicable. A barrel of oil thus saved is a barrel of oil that need not be made; or, a barrel of oil added to our reserves.

The simplest, easiest, quickest, and probably cheapest way to make oil from coal is to conserve our waning supplies of crude by substituting coal for fuel oils to the greatest possible extent. This is particularly evident when considering the magnitude of the new chemical industry required to produce annually 200,000,000 barrels of oil from coal. By comparison, the total consumption of petroleum, its products, and substitutes in Germany for all uses during 1939 has been estimated at only 54,000,000 barrels.

* * * * *

Great increase in oil from coal by coking is not expected: There are obtained from a ton of coal in byproduct coking about 9 gallons of coal tar and 3 gallons of light oil. Higher unit yields of oil from coal can be secured by coking at lower temperatures. The total supply of liquid fuels from coal by coking will unquestionably expand as the requirements for coke for house heating are expanded to create smokeless and healthful communities. Because the yields of oil from carbonizing coal at any temperature are relatively low, however, it is unlikely that this method of conserving our supplies of crude oil will ever be able to supply more than but a small fraction of our needs.

Senator O'MAHONEY. May I interrupt at that point? You say about 9 gallons of coal tar and 3 gallons of light oil are recoverable from a ton of coal.

Mr. DENIG. Right.

Senator O'MAHONEY. What remains?

Mr. DENIG. The remainder is coke-oven gas and coke. From each ton of coal you can figure roughly 12,000 cubic feet of coke-oven gas and about 1,400 pounds of coke.

Senator O'MAHONEY. So that there is a valuable by-product of coal left after the production of the tar and the oil?

Mr. DENIG. Yes, sir.

Senator O'MAHONEY. Thank you.

Mr. DENIG (reading):

Complete conversion of coal to liquid fuels: Because of a lack of indigenous petroleum, coupled with the probable difficulty of importing oil in sufficient amounts during war, certain European countries, notably Germany, have developed since the last World War two methods for converting coal almost entirely to oil. Many American companies had viewed these developments with more than passing interest. Several of these concerns and the United States Bureau of Mines have made preliminary studies of these processes from the standpoint of their adaptability to our own national fuel economy.

On the subject of high-pressure hydrogenation of coal, I will not go into that because it has been already reviewed, but I would like to read the last paragraph on page 7. [Reading:]

The Bergius process yields from coal a motor fuel containing high percentages of aromatic hydrocarbons which impart superior power and anti-knock properties to the product. Principal objection at present to the Bergius process are—

- (1) The very large capital costs of the high pressure equipment required;
- (2) The general unavailability of cheap hydrogen; and
- (3) The fact that some coals of high ash content and low rank (such as lignite) are not good raw materials.

On the next page I deal with the Fischer-Tropsch process and I would like to pass over that and go on to page 9, under the subheading "Cost of synthetic gasoline by the Fischer-Tropsch process." [Reading:]

In the accompanying appendix are presented detailed estimates of costs for producing synthetic gasoline by the Fischer-Tropsch process starting with coke and with natural gas as the basic raw materials. These estimates for American conditions have been based on, and adapted from, first-hand information concerning German pilot-plant and commercial practice obtained in that country during the early part of 1938. Since that time no actual costs have been obtained from that, or any other source.

Another less detailed and probably less accurate estimate has also been included for producing synthetic gasoline from a typical sub-bituminous coal.

These estimated costs assume capacity operation for 330 days per year, and include the usual fixed charges, but exclude profit. They are now summarized by table 1 (p. 11). The estimated costs of converting synthesis gas into the primary product or synthetic petroleum is constant at 6.4 cents per gallon and those for converting this primary product into synthetic gasoline by cracking and refining are fixed at 1.2 cents per gallon of finished gasoline. Losses in material during this conversion, for which no credit has been taken, amount to about 20 percent by volume.

Table 1 indicates that the estimated total costs of producing finished gasoline, under the assumed conditions, is 24.4 cents per gallon from coke, 18.2 cents per gallon from sub-bituminous coal, and 17.4 cents per gallon from natural gas.

I might say that I have assumed that the coke is valued at \$5 per ton, the sub-bituminous coal at a dollar per net ton, and the natural-gas sulfur-free at 5 cents per thousand cubic feet.

Congressman RANDOLPH. Would the witness also give us the high-volatile bituminous?

Mr. DENIG. The high-volatile bituminous: I have taken that only via the coke route, and I have assumed a figure here of \$2.75 per ton of coal routed to arrive at my ton of coke.

Congressman RANDOLPH. What would be the cost in terms of production? We had a report that said bituminous coal turned into gasoline by the hydrogenation process could be manufactured at 12 cents.

Mr. DENIG. I have heard that statement, but I have not seen any figures backing up that figure. [Reading:]

The only credits taken in these calculations have been for the surplus steam produced in the catalytic converters producing the primary product, and the propane-butane obtained during the cracking of this synthetic petroleum to gasoline. It will be obvious that by assuming that the plant is operated to produce not only synthetic gasoline but also other products such as waxes, and by taking credits for any surplus tail gas leaving the converters and the additional surplus gas produced by cracking the primary product, the cost of finished synthetic gasoline, by a system of joint accounting for coproducts and byproducts, doubtless can be materially reduced. This procedure has not been followed in these estimates because the values of some of these materials, when produced in large amounts under local American conditions, have not yet been established.

These estimated costs for American conditions during 1938, based wholly or in part on pilot-plant German experience as of 1938, can also probably be lowered somewhat by adopting technical improvements already made. Anticipated future developments will surely improve present-day economies of producing oil from coal in the United States.

* * * * *

The total investment required for a complete Fischer-Tropsch plant under pre-war American conditions, having a daily capacity of 1 910 barrels of finished gasoline, would have approximately \$12,000,000. This is equivalent to \$6.18) per barrel gasoline-capacity per day. The plant comprises equipment for making synthesis gas, its catalytic conversion to primary product, and cracking apparatus for processing to synthetic gasoline the entire amount of synthetic petroleum produced. Neither a boiler plant nor a power plant have been included, since surplus steam is made in the process itself, and electric power is purchased. What these costs would be today is somewhat conjectural, and to determine them with a moderate degree of accuracy would require the expenditure of considerable time and money.

From these estimates, the cheapest raw material for producing synthetic gasoline by the Fischer-Tropsch process appears to be natural gas. It must not be concluded from such figures, however, that research, development, and plant design and construction should be based chiefly on natural gas as the principal raw material.

Our national coal reserves are enormous, probably sufficient to last for a thousand years even though our entire future supply of motor fuel were derived from coal. While the known natural-gas reserves appear to be ample for the immediate future, they are relatively minor when compared with those for coal. Any consideration of using natural gas for synthetic gasoline must include a careful reappraisal of our natural-gas reserves.

Making synthesis gas commercially from coal presents technical problems of considerable magnitude. The manufacture of synthesis gas from natural gas is less difficult. From the long-range point of view it would be wise to concentrate first on the solution of those major difficulties that must be overcome eventually in developing a new synthetic-petroleum industry in this country.

The appendix details the amount of steel required to construct a typical Fischer-Tropsch plant. This is equivalent to 14 tons of ordinary steel per barrel of gasoline produced per day.

Senator O'MAHONEY. May I interrupt, Mr. Denig?

Mr. DENIG. Yes.

Senator O'MAHONEY. Would it be a justifiable conclusion, from what you say, that in your opinion we should attempt the development of gasoline from coal rather than from natural gas although it could be done more cheaply by the natural gas?

Mr. DENIG. That is my opinion.

Senator O'MAHONEY. Thank you, sir.

Mr. DENIG (reading):

Advantages of Fischer-Tropsch process: Although in some specific localities under special conditions it may be found advantageous to adopt the Bergius process, the Fischer-Tropsch process has at least these five technical advantages over the Bergius process:

1. Almost any kind of solid, liquid, or gaseous fuel can be used as raw material;
2. No costly equipment, difficult to fabricate and to operate at very high pressures, is required;
3. Plants need not be as large in order to obtain maximum economy—

Senator O'MAHONEY. Would you develop No. 3 just a little—plants need not be as large as what?

Mr. DENIG. They need not be as large as the Bergius process in order to secure the same price material. In order for the Bergius process to operate at its lowest cost, it is essential to have very large units, whereas the Fischer-Tropsch process is more amenable to smaller units in order to achieve a reasonably low cost of operation.

Senator O'MAHONEY. Well what, in your opinion, would be the minimum size of plant which would add materially to our knowledge of this process?

Mr. DENIG. You mean experimental plant?

Senator O'MAHONEY. Yes; sure.

Mr. DENIG. I would say something in the order of 100 barrels per day.

Senator O'MAHONEY. You think that would be large enough?

Mr. DENIG. I think that that would give us a pretty good working knowledge of the subject.

Senator O'MAHONEY. You think by having plants of that kind in various parts of the country we could develop the necessary research information to bring about the maximum development of the art of producing oil from coal or shale?

Mr. DENIG. I do.

Senator O'MAHONEY. Thank you, sir.

Mr. DENIG (continuing):

4. Lubricating oil and numerous chemical products can be made; and,

5. The equipment has greater flexibility and offers greater opportunity for further technical and economic improvements.

The raw material and a substantial part of the apparatus required for the Fischer-Tropsch process can, for example, be adapted to the production of methanol (wood alcohol).

This product is another chemical of many applications, which can also be used as a motor fuel. Fischer-Tropsch plants can also be integrated with other operations. For example, water-gas plants supplying city gas are often operated only in the winter or as standby capacity. They could produce synthesis gas when not otherwise utilized. A new type of synthetic-chemical industry should be another important result of developing on a commercial scale the Fischer-Tropsch and similar processes in the United States.

For these reasons, the building of a full-size Fischer-Tropsch plant in this country using coal as the raw material is clearly indicated, and is required for commercially exploring the manufacture of synthetic oils and other chemicals from our abundant resources of low-grade solid fuels. Only in this way can the economics of the process under American conditions be established conclusively. In addition, there is no other way to make possible the testing of inventions on a practical scale.

Senator O'MAHONEY. What would be a full-sized Fischer-Tropsch plant?

Mr. DENIG. It would be one producing 30,000 tons per year, which would be the equivalent of about 600 barrels per day.

Senator O'MAHONEY. How much raw material would such a plant use?

Mr. DENIG. A plant producing 30,000 tons of synthetic fuel a year would require roughly 140,000 tons of coal per year.

Senator O'MAHONEY. That is somewhat larger than the plants which you indicated a moment ago.

Mr. DENIG. Well, the plant that I indicated, the 100-barrel-a-day plant that I indicated a moment ago, I think would be ample for

experimental purposes, would give us all the technical information that we needed, whereas a smaller-sized commercial plant, in order to get a full study of the costs of operation, and so forth, would have to be of that order and magnitude.

Senator O'MAHONEY. Is there, in your opinion, any possibility that any private company now operating, either in the field of producing coal or in the field of producing petroleum, would be willing to make the investment necessary to make such tests as are contemplated by this bill?

Mr. DENIG. Well, I am a little bit skeptical that there is any such company. Our company, the Koppers Co., is carrying on experimental work on the Fischer-Tropsch process, but with the prices of oil, I doubt if it would be willing to build any such plant until it appears that the thing, the time of economic justification, is closer than it is at the present moment.

Senator O'MAHONEY. So that if the work is to be done, it must necessarily be done by the Government?

Mr. DENIG. Yes, sir.

Senator O'MAHONEY. Thank you.

Senator MURDOCK. May I ask: Suppose that we should, through the Bureau of Mines, build a number of these smaller plants, which you say should give us the necessary engineering data; after that has been done and that information is available, then would it not be probable that your private industry would step into the picture with the big plants?

Mr. DENIG. I think so.

Senator MURDOCK. Then is it your opinion that the Government should not only build these smaller plants of 100 barrels capacity at this time, but should also go into the large commercial plant which you indicate?

Mr. DENIG. I think that the Government should go into the larger plants only, far enough to establish definitely the necessary costs of operation, and by that I mean this, that perhaps the Government should have, say, a plant of the Bergius type and a plant of the Fischer-Tropsch type, of reasonable size, to demonstrate that all the kinks have been worked out and the economics are sound.

Senator MURDOCK. Well, now, would your smaller plants be for the purpose of demonstrating?

Mr. DENIG. The real small plant, such as we call the pilot plants, the jump from them to full-scale operation is always a dangerous jump, and in transferring this information sometimes bad errors of judgment are made.

The first commercial plant, built as a result of pilot plant operation, sometimes goes through a very arduous period before it is shaken down to an economic, sound practice.

Senator MURDOCK. I don't quite understand just what you are advocating; whether you are advocating the moving ahead by the Government at this time on both the small plants and the large plants.

Mr. DENIG. A reasonably sized plant; yes.

Senator MURDOCK. It is your opinion that the Government should undertake simultaneously these smaller plants and a reasonable-sized commercial plant?

Mr. DENIG. In due time, when it looks as if it is a sound move.

Senator O'MAHONEY. What would be a full-sized plant?

Mr. DENIG. I would say 30,000 tons a year.

Senator O'MAHONEY. Very well. You may proceed.

Mr. DENIG (reading):

Germany's problem of securing an adequate supply of motor fuel during this war is probably at least as acute as has been our own problem of obtaining synthetic rubber sufficient for our wartime needs. For this reason, numerous technical improvements in the Fischer-Tropsch process doubtless have been made in the Axis countries since 1939. The planning of such a pioneer commercial-size plant requires considerable time. This should be started soon so that the technical advances made by our enemies throughout this war can be secured and incorporated immediately upon its conclusion. Such a procedure doubtless will reduce the final investment in the plant and lower the costs of the motor fuel and other products made.

Conclusion: In a country so large as our own, blessed as it is with natural resources of so many different kinds, reliance need not, and should not, be placed on any one method for guaranteeing our future supplies of oil. Each section of the country will rely on those fuels and processes which are most economical there to use. Gasoline from shale oil produced in Colorado and in Utah would not be used in New York City. Motor fuel made from coal by the Fischer-Tropsch process in Wyoming or in western Pennsylvania would not be marketed in Tulsa. Alcohol from sorghum grown in Louisiana, or from surplus wheat, corn, or from some new crop raised in the Grain Belt, probably would not be shipped for blending with gasoline in Seattle. It also follows that, in the future, greater flexibility and adaptability of carburetors and engines will be required to match a variety of fuels, instead of tailoring the fuel to the engine.

It is believed that the Congress, by the passage of wise legislation in the near future, can encourage the manufacture of synthetic motor fuels and other oils from coal, so that our country can meet crises in our fuel supplies without changing unduly the habits of the people; safeguard the national economy; lay the foundation for new industries; and provide new jobs for our demobilized citizens.

If a continuous practical study of these alternative fuels is carried out as has been outlined, and if the savings of petroleum—now possible and practicable—are made by substituting coal for much oil, then our children and their progeny need have little cause for concern over an adequate supply of liquid fuels, indispensable both for the decentralized manner of peaceful suburban living which is so much to be desired, and for the future internal and external security of our Nation.

Some of these objectives can be achieved by the passage of S. 1243. Its enactment into law, with the further limitation that the major funds to be provided will be expended for only three small but commercial-size plants, one each for producing oil from shale, oil from coal by the Bergius process, and oil from coal by the Fischer-Tropsch process, is now supported.

Senator O'MAHONEY. Before we begin with our questions, I would like to point out that the committee has made arrangements to hear the following witnesses, whom I understand are in the room ready to testify. I would like to be sure that all who are on this list are present.

May I ask those whose names I read to arise or to indicate otherwise their presence here and their willingness to be heard this afternoon?

H. H. Lowry, director, coal research laboratory, Carnegie Institute of Technology.

Mr. LOWRY. Here.

Senator O'MAHONEY. Dr. A. W. Gauger, director of mineral industries research, the Pennsylvania State College.

Mr. Richard Maize, secretary, Pennsylvania Department of Mines, is here.

Dr. M. M. Leighton, chief, Illinois State Geological Survey.

Mr. Howard N. Eavenson, president of the Clover Splint Coal Co., Inc.

Mr. Andrew B. Clinton, mining engineer and coal operator, president of the Johnstown Coal & Coke Co., of Johnstown, Pa. Is he here? (No response.)

Senator O'MAHONEY. I read this list merely to suggest to myself and to the other members of the committee that we hold our questions down to a minimum so that all these gentlemen may make their contribution to the hearing.

Congressman RANDOLPH. In view of that observation, Mr. Chairman, I will put my thoughts into, perhaps, an observation rather than questions.

I think it is noteworthy and wholesome that the coal industry, the viewpoint of which is expressed here by this witness, suggests as one of the five plans on which this statement is made for research in the future, No. 3, the use of replaceable products. In other words, agricultural products for the coal hydrogenation.

We are interested in all these other phases, but for you to come here as a coal man and say we must give attention to using farm products for the making of gasoline in the future, I think that is a fine statement, and we congratulate the men who stand behind it, because certainly in the future, all these agricultural products are going to be used.

Senator O'MAHONEY. Your statement, Congressman, prompts me to point out that we have this afternoon heard a representative of the Gulf Research, the president of the Koppers Co., and the present witness, Mr. Denig, director of research for the Koppers Co., each of whom speaks for highly organized private industry, and each of whom has given his unqualified approval to this suggested activity by the Government.

It testifies to the cooperation that goes on constantly between business and the Government, a cooperation that is frequently lost sight of, I think, in the dispatches and in the radio comments that come out of Washington. There is a good deal more cooperation in America than there is conflict, so far as business and Government are concerned.

It is also worthy of note that representatives of the surrounding States have also spoken in favor of this legislation.

Senator DAVIS. I have just finished reading Mr. Williams' report here and it has made a tremendous impression upon me. I am of the opinion that the sooner we get to this and pass this legislation the better off we are.

Senator O'MAHONEY. Congressman Kelley?

Congressman KELLEY. Mr. Denig, is it possible to extract gasoline from the gas produced in the carbonization of coal?

Mr. DENIG. In carbonized coal, one of the byproducts we get is what is known as coke oven light oil, and that material is composed of benzene, toluene, and xylenes.

In wartime, of course, benzene and toluene go into the munitions business. In normal times the bulk of the benzene and toluene is used as motor fuel because of its excellent and high-anti-knock properties.

Congressman KELLEY. You said something about the solid fuels in the internal-combustion engine. I take it that is pulverized coal?

Mr. DENIG. Yes, sir.

Congressman KELLEY. The difficulty, as I understand it, is the removal of the noncombustible material in the coal?

Mr. DENIG. Of the ash.

Congressman KELLEY. Has any progress been made in that direction?

Mr. DENIG. Yes; both in the United States and abroad, in the design of engines for the direct utilization of such solid fuel. I think shortly after the war you will see a number of concerns that will put out such engines.

Congressman KELLEY. Do I understand you to say that low-grade coals do not offer themselves well for the acquisition of gasoline?

Mr. DENIG. They lend themselves well, providing you pick the right process. For example, your subbituminous and lignite coals, I think, are very amenable to treatment by the Fischer-Tropsch process, and I think a little less so by the Bergius process, unless you can find such coals with a very low ash content.

Now, in order to have the Bergius process operate satisfactorily, at least in the state of our present ignorance, we must have a low ash fuel, and very few of these subbituminous coals are low ash. There are exceptions, of course, such as the famous bed in Wyoming. That is one instance.

Congressman KELLEY. That is all.

Senator O'MAHONEY. Thank you very much, Mr. Denig. We are indeed grateful to you.

(The statement submitted by J. P. Williams and read in part by Mr. Denig is as follows:)

THE MANUFACTURE OF MOTOR FUELS AND SYNTHETIC PETROLEUM, ESPECIALLY FROM COAL

A Statement by J. P. Williams, Jr., President Koppers Co., Pittsburgh, Pa., Before the Subcommittee on War Minerals of the Committee on Public Lands and Surveys, United States Senate, on S. 1243, Seventy-eighth Congress, first session

(Submitted and read in part by Fred Denig)

BYPRODUCT COKING PRODUCES LIQUID FUELS FROM COAL

This year the byproduct coke industry celebrates the fiftieth anniversary of its birth in the United States. The first such plant was built in this country during 1893, at Syracuse, N. Y., for producing ammonia required for manufacturing soda ash. That plant was not initially equipped to recover light oil, but coal tar was obtained as one of the primary liquid products. Light oil was first recovered at a coke plant in this country during 1900.

Most coal-tar is now distilled to produce raw materials required for end-products such as plastics, dyestuffs, disinfectants, and medicinals. Hundreds of millions of gallons of coal-tar and residual coal-tar are burned each year as liquid fuel, principally in open-hearth furnaces at steel works. Thus liquid fuels made from coal have been produced commercially in the United States annually since 1893. Coal-oil (kerosene) for the lamps of China was in fact originally made from coal.

Light oil is obtained as another primary liquid product by coking selected bituminous coals. It is refined into these three principal products—benzene, toluene, and xylenes. Everyone today knows that toluene is the base for the military explosive TNT. A recent important use for one of the xylenes is in the manufacture of synthetic vitamin B₁. While large amounts of benzene are now required for styrene for synthetic rubber, it is probable that the largest present demand for benzene is in manufacturing cumene which is needed in the production of 100-octane aviation gasoline. Thus today the byproduct coke plants of the country are vital producers of liquid fuels from coal: not only for steel but also for the fighting planes of the Allied Nations.

The byproduct coke industry is indeed a basic key industry serving agriculture and all industries requiring such raw materials as iron, steel, fertilizers, manufactured gas, and numerous organic chemicals having almost infinite applications. It is not an exaggeration to state that modern civilization today depends on coal, coke, and petroleum for its very existence and preservation. In the foreseeable future our industrial and cultural progress may be paced fundamentally by our as yet imperfect knowledge about coal and its efficient utilization.

PLAN NOW FOR FUTURE SUPPLIES OF OIL

The coal and byproduct coke industries share naturally the anxiety of the Government and our citizens, and of the petroleum industry and its millions of customers, over our natural resources of petroleum for the present, the years just ahead, and for the more uncertain future. It is not now too soon to plan broadly and boldly for our post-war supplies of gasoline, Diesel and other fuel oils required for the Nation's peacetime economy and for the future security of our country.

Petroleum geologists agree that oil reserves are irreplaceable natural resources. It is obvious to those considering this subject that our supply underground is diminishing all too rapidly. Discoveries of new oil are not keeping abreast with the ever-increasing demands. Many competent experts now believe that the United States possesses within its continental boundaries less than 20 years' proven supply at current rates of consumption. Since petroleum engineers state that it is impossible to produce all oil now located underground within the next 20 years, a general peacetime shortage may be experienced years before 1960.

It is clearly evident that the problem of supplying our future needs for petroleum and its products is pressing for attention. An adequate answer to this vexing question has not yet been found.

IMPORTANT METHODS FOR ASSURING FUTURE SUPPLIES OF OIL

These five methods for assuring our future supplies of petroleum merit careful consideration at this time:

1. Husband our present resources (and other reserves still to be discovered) by restricting the use of natural petroleum, and by substituting lower-grade and more abundant fuels as far as is possible;

2. Augment the supply of our indigenous petroleum by distilling or retorting oil shale;

3. Manufacture liquid fuels for internal-combustion engines from replaceable sources such as agricultural products;

4. Adopt and improve known procedures for using solid fuels for internal-combustion engines; and

5. Develop processes for producing synthetic oils from other natural resources such as coal, the supply of which—although not inexhaustible—is so enormous as to cause no concern for many centuries to come.

USING OIL AS LOW-GRADE FUEL SHOULD BE DISCOURAGED

During the years just prior to the outbreak of this World War, about 500,000,000 barrels a year, or 43 percent by volume of our new supply of domestic crude oil, were used in the United States as motor fuel. About 450,000,000 barrels a year, or 38 percent of the entire new domestic supply, were consumed annually as fuel for purposes other than in automotive vehicles. Much of it was used, and is still being consumed, as fuel for househeating. A large percentage of this consumption, however, perhaps nearly half of it, or about 200,000,000 barrels of oil per year, was burned as low-grade fuel, principally for raising steam on land, not on ships.

Such economic wastage of potentially high-grade fuel for low-grade purposes greatly accelerates the decline of our petroleum reserves. By modern refinery technique much of this oil could have been, and in the future should be, diverted to the production of gasoline, thereby reducing the national requirements for crude oil. Advances in the art of burning solid fuels also make such a saving possible and practicable. A barrel of oil thus saved is a barrel of oil that need not be made; or, a barrel of oil added to our reserves.

The simplest, easiest, quickest, and probably the cheapest way to make oil from coal is to conserve our waning supplies of crude by substituting coal for fuel oils to the greatest possible extent. This is particularly evident when considering

the magnitude of the new chemical industry required to produce annually 200,000,000 barrels of oil from coal. By comparison, the total consumption of petroleum, its products, and substitutes in Germany for all uses during 1939 has been estimated at only 51,000,000 barrels.

OIL FROM SHALE SHOULD BE ENCOURAGED

One of the great undeveloped natural resources of the United States for securing additional supplies of natural oil resides in our enormous deposits of oil shale in the western part of the country. Probably the best way to develop improved equipment for recovering oil from this shale would be to aid the United States Bureau of Mines to extend its excellent preliminary work by making available funds for the construction of several different types of oil-shale retorts. This full-size equipment should be built in collaboration with industrial organizations already familiar with such plants.

MOTOR FUEL FROM AGRICULTURAL PRODUCTS MERITS CONTINUED ATTENTION

The manufacture of automotive fuels from replaceable agricultural products is, of course, well known and much discussed. This perennial subject is under continuous investigation in this country and throughout the rest of the world. Such proposals cannot hope to succeed in the United States when the value of crude oil at the well is only \$1.25 per barrel. In view of the developments being made continually in the growing and harvesting of crops, in fermentation, and in distillation and other chemical-engineering procedures, unquestionably there will come a time—perhaps not far distant—when grain alcohol, butyl alcohol, or some other liquid fuel from the farm can supplant at least some gasoline as fuel for automotive vehicles in certain parts of our country. Perhaps a new crop should be grown just for this particular purpose. Not only the juice of the plant, but the solid portions of it as well, could be converted largely into ethyl alcohol. Chemurgy is still in its infancy, and the production of industrial products such as motor fuel from farm crops merits encouragement; not only from the standpoint of prolonging our reserves of petroleum, but also from the viewpoint of the millions of new jobs needed for our post-war economy.

SOLID FUELS FOR INTERNAL-COMBUSTION ENGINES

In many parts of the world possessing little or no petroleum, the use of solid fuels for propelling automotive vehicles is now common. Charcoal, cokes made at various temperatures from coal, lignite briquets, and other solid fuels are gasified in small producers mounted on the vehicle itself. Suction from the engine draws air through the incandescent fuel-bed thereby producing a combustible gas which is admixed with air and exploded in the engine to produce the motive-power required. As one of the results of this war, such application of solid fuels has been further developed and improved.

Powdered coal has also been proposed for direct use as a fuel in Diesel engines. It seems improbable that this development, and gas producers for automobiles and trucks, will become important in the United States in the near future. Considering our outlying possessions, however, the best typical examples of such commercial equipment now, and soon to be, available abroad might be secured, tested, modified, and further developed for isolated and special conditions to determine whether or not this is a further means of conserving our own future supply of petroleum.

GREAT INCREASE IN OIL FROM COAL BY COKING IS NOT EXPECTED

There are obtained from a ton of coal in byproduct coking about 9 gallons of coal tar and 3 gallons of light oil. Higher unit yields of oil from coal can be secured by coking at lower temperatures. The total supply of liquid fuels from coal by coking will unquestionably expand as the requirements for coke for house heating are expanded to create smokeless and more healthful communities. Because the yields of oil from carbonizing coal at any temperature are relatively low, however, it is unlikely that this method of conserving our supplies of crude oil will ever be able to supply more than but a small fraction of our needs.

COMPLETE CONVERSION OF COAL TO LIQUID FUELS

Because of a lack of indigenous petroleum, coupled with the probable difficulty of importing oil in sufficient amounts during war, certain European countries, notably Germany, have developed since the last World War two methods for converting coal almost entirely to oil. Many American companies had viewed

these developments with more than passing interest. Several of these concerns, and the United States Bureau of Mines, have made preliminary studies of these processes from the standpoint of their adaptability to our own national fuel economy.

HIGH-PRESSURE HYDROGENATION OF COAL

The first process commercialized in Germany for the production of synthetic oils was the Bergius process for the direct hydrogenation of coal. In this procedure, finely powdered coal is mixed with part of the process oil to form a paste. Hydrogen and a catalyst are added. This mixture is then passed through a series of high-pressure, high-temperature reaction vessels in which the coal substance is converted largely into a mixture of oils which are subsequently separated into motor fuel, Diesel oils, and fuel oils.

The United States Bureau of Mines has already completed much excellent experimental work on this hydrogenation process, and further work on a larger scale is next required to determine commercial yields and costs. Several American companies are capable of designing a commercial plant based on data already secured by the United States Bureau of Mines and the further engineering data which probably has been and can be obtained from England. As soon as Germany is defeated, capable engineers should be sent into that country to obtain additional information concerning all current improvements made there.

Although the initial cost of gasoline made by the Bergius process in the United States would probably be several times the present cost of gasoline from natural petroleum, nevertheless one such commercial-size plant should be built soon, preferably at the close of the war so that the latest German developments can be incorporated. This first plant probably would require financial assistance from the Government since private capital might not initially risk such a venture. The installation doubtless should be made jointly by the United States Bureau of Mines and one or two American companies having strong incentives for producing oil from coal. After this equipment has been operated and improved on for 5 or 10 years, the data then would be available upon which to base an intelligent decision as to what further steps, if any, should be taken.

The Bergius process yields from coal a motor fuel containing high percentages of aromatic hydrocarbons which impart superior power and antiknock properties to the product. Principal objections at present to the Bergius process are: (1) the very large capital costs of the high-pressure equipment required; (2) the general unavailability of cheap hydrogen; and (3) the fact that some coals of high ash content, and low rank (such as lignite), are not good raw materials.

LOW-PRESSURE CONVERSION OF COAL AND OTHER FUELS TO OIL

The second method for converting coal into synthetic oils is known as the Fischer-Tropsch process. According to this procedure, almost any solid, liquid, or gaseous fuel can be converted into synthetic gasoline, lubricants, and fuel oils for Diesel engines and automotive vehicles.

The Fischer-Tropsch process itself comprises two principal separate steps: (1) Production of the synthesis gas, and (2) the catalytic conversion of this synthesis gas to primary liquid product which can be here designated as synthetic petroleum. A third and final step is the conversion of this synthetic petroleum into salable finished products such as synthetic gasoline, Diesel oils, lubricants, and other products by the usual technique of the natural-petroleum refinery.

Synthesis gas consists essentially of two-thirds hydrogen and one-third carbon monoxide, both by volume. Other ratios have been tried experimentally and eventually may prove to be more satisfactory. This gas is usually made by gasifying solid fuels such as lignite, coal, or coke in large water-gas generators to produce what is known technically as blue water gas. Since such gas is deficient in hydrogen, additional hydrogen, obtained either from some of the blue gas itself or by treating coke-oven gas, must be added to the blue water gas to form synthesis gas.

Synthesis gas can also be made by gasifying noncoking coals or lignite in a gas producer blown with oxygen instead of with air. Natural gas can be converted readily and directly to synthesis gas for the Fischer-Tropsch process. The numerous methods proposed and used for making synthesis gas from different raw materials are quite technical and need not now here be described.

If the synthesis gas, from whatever source obtained, contains impurities such as sulfur compounds, these must be removed to insure a long life for the catalyst employed in combining these gases chemically to form the primary liquid product.

After its production and purification, the synthesis gas is pumped through low- or medium-pressure catalytic converters operating at moderate temperatures

to form the complex mixture of oils and waxes known as the primary liquid product, or synthetic petroleum.

The third step may comprise a number of different operations, depending on the character and amount of the final end-products desired. By usual petroleum-refinery technique, synthetic petroleum can be converted into motor fuel, Diesel oils, lubricants, and other products. The low-octane synthetic gasoline obtained is further processed to increase its antiknock value. Waxes obtained in the primary product can be used as raw materials for fatty acids and soaps. Numerous chemicals of utility and value can be produced from the synthetic petroleum made by the Fischer-Tropsch process.

COST OF SYNTHETIC GASOLINE BY THE FISCHER-TROPSCH PROCESS

In the accompanying appendix are presented detailed estimates of costs for producing synthetic gasoline by the Fischer-Tropsch process, starting with coke and with natural gas as the basic raw materials. These estimates for American conditions have been based on, and adapted from, first-hand information concerning German pilot-plant and commercial practice obtained in that country during the early part of 1938. Since that time no actual costs have been obtained from that, or any other source.

Another less-detailed and probably less-accurate estimate has also been included for producing synthetic gasoline from a typical sub-bituminous coal.

These estimated costs assume capacity operation for 330 days per year, and include the usual fixed charges, but exclude profit. They are now summarized by table 1 (p. 11). The estimated costs of converting synthesis gas into the primary product or synthetic petroleum is constant at 6.4 cents per gallon, and those for converting this primary product into synthetic gasoline by cracking and refining are fixed at 1.2 cents per gallon of finished gasoline. Losses in material during this conversion, for which no credit has been taken, amount to about 20 percent by volume.

Table 1 indicates that the estimated total costs of producing finished gasoline, under the assumed conditions, is 24.4 cents per gallon from coke, 18.2 cents per gallon from sub-bituminous coal, and 17.4 cents per gallon from natural gas.

The only credits taken in these calculations have been for the surplus steam produced in the catalytic converters producing the primary product, and the propane-butane obtained during the cracking of this synthetic petroleum to gasoline. It will be obvious that by assuming that the plant is operated to produce not only synthetic gasoline but also other products such as waxes, and by taking credits for any surplus tail gas leaving the converters and the additional surplus gas produced by cracking the primary product, the cost of finished synthetic gasoline, by a system of joint accounting for coproducts and byproducts, doubtless can be materially reduced. This procedure has not been followed in these estimates because the values of some of these materials, when produced in large amounts under local American conditions, have not yet been established.

These estimated costs for American conditions during 1938, based wholly or in part on pilot-plant German experience as of 1938, can also probably be lowered somewhat by adopting technical improvements already made. Anticipated future developments will surely improve present-day economics of producing oil from coal in the United States.

TABLE 1.—*Estimated costs of producing synthesis gas, primary liquid product (synthetic petroleum), and synthetic gasoline from three different raw materials by the Fischer-Tropsch process*

Raw material	Cost of synthesis gas for 1 gallon primary product	Cost of 1 gallon primary product	Total cost of 1 gallon finished synthetic gasoline
	Cents	Cents	Cents
Coke.....	12.2	18.6	24.4
Sub-bituminous coal.....	7.3	13.6	18.2
Natural gas.....	6.6	13.0	17.4

NOTE.—The assumed costs for raw materials at the plant are: Coke, \$5 per net ton; sub-bituminous coal, \$1 per net ton; natural gas (sulfur-free), 5 cents per thousand cubic feet.

The total investment required for a complete Fischer-Tropsch plant under pre-war American conditions, having a daily capacity of 1,940 barrels of finished gasoline, would have approximated \$12,000,000. This is equivalent to \$6,180 per barrel gasoline capacity per day. The plant comprises equipment for making synthesis gas, its catalytic conversion to primary product, and cracking apparatus for processing to synthetic gasoline the entire amount of synthetic petroleum produced. Neither a boiler plant nor a power plant has been included, since surplus steam is made in the process itself, and electric power is purchased. What these costs would be today is somewhat conjectural, and to determine them with a moderate degree of accuracy would require the expenditure of considerable time and money.

From these estimates, the cheapest raw material for producing synthetic gasoline by the Fischer-Tropsch process appears to be natural gas. It must not be concluded from such figures, however, that research, development, and plant design and construction should be based chiefly on natural gas as the principal raw material.

Our national coal reserves are enormous, probably sufficient to last for a thousand years even though our entire future supply of motor fuel were derived from coal. While the known natural-gas reserves appear to be ample for the immediate future, they are relatively minor when compared with those for coal. Any consideration of using natural gas for synthetic gasoline must include a careful reappraisal of our natural-gas reserves.

Making synthesis gas commercially from coal presents technical problems of considerable magnitude. The manufacture of synthesis gas from natural gas is less difficult. From the long-range point of view, it would be wise to concentrate first on the solution of those major difficulties that must be overcome eventually in developing a new synthetic-petroleum industry in this country.

The appendix details the amount of steel required to construct a typical Fischer-Tropsch plant. This is equivalent to 14.0 tons of ordinary steel per barrel of gasoline produced per day.

ADVANTAGES OF THE FISCHER-TROPSCH PROCESS

Although in some specific localities under special conditions it may be found advantageous to adopt the Bergius process, the Fischer-Tropsch process has at least these five technical advantages over the Bergius process:

1. Almost any kind of solid, liquid, or gaseous fuel can be used as raw material;
2. No costly equipment, difficult to fabricate and to operate at very high pressures, is required;
3. Plants need not be as large in order to obtain maximum economy;
4. Lubricating oil and numerous chemical products can be made; and
5. The equipment has greater flexibility and offers greater opportunity for further technical and economic improvements.

The raw material and a substantial part of the apparatus required for the Fischer-Tropsch process can, for example, be adapted to the production of methanol ("wood" alcohol). This product is another chemical of many applications, which can also be used as a motor fuel. Fischer-Tropsch plants can also be integrated with other operations. For example, water-gas plants supplying city gas are often operated only in the winter or as stand-by capacity. They could produce synthesis gas when not otherwise utilized. A new type of synthetic-chemical industry should be another important result of developing on a commercial scale the Fischer-Tropsch and similar processes in the United States.

For these reasons, the building of a full-size Fischer-Tropsch plant in this country using coal as the raw material is clearly indicated, and is required for commercially exploring the manufacture of synthetic oils and other chemicals from our abundant resources of low-grade solid fuels. Only in this way can the economics of the process under American conditions be established conclusively. In addition, there is no other way to make possible the testing of inventions on a practical scale.

Germany's problem of securing an adequate supply of motor fuel during this war is probably at least as acute as has been our own problem of obtaining synthetic rubber sufficient for our wartime needs. For this reason, numerous technical improvements in the Fischer-Tropsch process doubtless have been made in the Axis countries since 1939. The planning of such a pioneer commercial-size plant requires considerable time. This should be started soon so that the technical advances made by our enemies throughout this war can be secured and incorporated immediately upon its conclusion. Such a procedure

doubtless will reduce the final investment in the plant and lower the costs of the motor fuel and other products made.

CONCLUSION

In a country so large as our own, blessed as it is with natural resources of so many different kinds, reliance need not, and should not, be placed on any one method for guaranteeing our future supplies of oil. Each section of the country will rely on those fuels and processes which are most economical there to use. Gasoline from shale oil produced in Colorado and in Utah would not be used in New York City. Motor fuel made from coal by the Fischer-Tropsch process in Wyoming or in western Pennsylvania would not be marketed in Tulsa. Alcohol from sorghum grown in Louisiana, or from surplus wheat, corn, or from some new crop raised in the Grain Belt, probably would not be shipped for blending with gasoline in Seattle. It also follows that, in the future, greater flexibility and adaptability of carburetors and engines will be required to match a variety of fuels, instead of tailoring the fuel to the engine.

It is believed that the Congress, by the passage of wise legislation in the near future, can encourage the manufacture of synthetic motor fuels and other oils from coal, so that our country can meet crises in our fuel supplies without changing unduly the habits of the people; safeguard the national economy; lay the foundations for new industries; and provide new jobs for our demobilized citizens.

If a continuous practical study of these alternative fuels is carried out as has been outlined, and if the savings of petroleum—now possible and practicable—are made by substituting coal for much oil, then our children and their progeny need have little cause for concern over an adequate supply of liquid fuels, indispensable both for the decentralized manner of peaceful suburban living, which is so much to be desired, and for the future internal and external security of our Nation.

Some of these objectives can be achieved by the passage of S. 1243. Its enactment into law, with the further limitation that the major funds to be provided will be expended for only three small but commercial-size plants, one each for producing oil from shale, oil from coal by the Bergius process, and oil from coal by the Fischer-Tropsch process, is now supported.

APPENDIX

The cost of making motor fuel by the Fischer-Tropsch process

The costs that follow are based on first-hand data obtained from authoritative sources in Germany during the early part of 1938. They have been adapted for and converted to pre-war American conditions. At that time, certain steps in the entire process were still in the development or pilot-plant stage, particularly those relating to the production of synthesis gas from natural gas, and the medium-pressure catalytic conversion of the synthesis gas to primary liquid product.

These estimates presume capacity operation for 330 days per year, and include fixed charges, but exclude profit. It is further predicated that the entire primary liquid product will be converted as completely as possible into synthetic gasoline. They exclude the possibility of operating in such a way as to produce lubricating oils, waxes, and other coproducts and byproducts, for which some credit might be taken to reduce the final net cost of the gasoline produced. The only such deductions taken, when appropriate, have been for surplus steam, and propane-butane.

The Fischer-Tropsch process consists of two separate and distinct stages of manufacture.

The first stage is the manufacture of the synthesis gas, which is essentially two-thirds hydrogen and one-third carbon monoxide. This synthesis gas may be made from various raw materials, and the manufacturing cost will be given for gas made from three typical raw materials: Sub-bituminous coal, coke, and natural gas.

The second stage is the conversion of the synthesis gas into the synthetic petroleum or primary product as it is called. From this primary product gasoline and other petroleum products may be made by much the same processes

as are used to convert natural petroleum into gasoline, etc. The costs given here will be based on 1 gallon of the primary product.

A. Cost of synthesis gas made from coke.—The normal manner of expressing cost of gas manufacture is as so many cents per thousand cubic feet. However, for convenience and to avoid any confusion, the costs will be given as so many cents per gallon of primary product that will finally result. It requires 680 cubic feet of ideal synthesis gas ($\frac{2}{3}$ hydrogen, $\frac{1}{3}$ carbon monoxide) to make 1 gallon of primary product.

It will be assumed that the coke will be made in a plant adjacent to coal mines and that it will be available at the relatively low price of \$5 per ton.

Cost item:

	<i>Cents per gallon primary product</i>
1. Water-gas manufacture:	
a. Coke -----	6.69
b. Labor -----	0.71
c. Capital cost -----	1.05
d. Total, water gas -----	8.45
2. Conversion to synthesis gas (operation, 0.22, capital, 0.16) -----	0.38
3. Purification (operation, 1.08; capital, 0.40) -----	1.48
4. Compression (operation, 1.61; capital, 0.29) -----	1.90
5. Total, synthesis gas -----	12.24

B. Cost of synthesis gas made from subbituminous coal.—It is assumed that a good quality subbituminous coal will be available at the plant for a total delivered cost of \$1 per ton. This will be converted into synthesis gas by the Didier process. The estimated costs for the synthesis gas are:

Cost item:

	<i>Cents per gallon primary product</i>
1. Coal -----	1.47
2. Labor -----	1.00
3. Capital cost -----	1.40
4. Purification -----	1.48
5. Compression -----	1.90
6. Total, synthesis gas -----	7.25

C. Cost of synthesis gas made from natural gas.—Since no natural gas is available in Germany, it was impossible to obtain commercially proven cost figures on manufacture of synthesis gas from this raw material. However, there was in operation in Germany in 1938 a large pilot plant using the so-called Linde-Karwat process for converting coke-oven gas into synthesis gas. This involved the conversion of the methane present in coke-oven gas into synthesis gas and, since natural gas is substantially methane, the process should be applicable to natural gas.

The Linde-Karwat process involves essentially a chemical reaction at high temperatures between methane and oxygen, thereby producing synthesis gas in one step. It will be assumed that natural gas at the plant will be available at 5 cents per thousand cubic feet. In addition to the natural gas, there would be required electric power for production of the oxygen from air, some coke that is consumed in small quantity in the reaction tower, and power for compression of the synthesis gas, in addition to usual cost of labor, capital charges, etc. No purification cost is included, since it is assumed that the natural gas is sulfur-free.

Cost item:

	<i>Cents per gallon primary product</i>
1. Natural gas -----	1.16
2. Electric power (for oxygen production) -----	1.34
3. Coke -----	0.42
4. Water, etc -----	0.48
5. Labor -----	0.53
6. Compression -----	1.48
7. Capital cost and maintenance (17 percent) -----	1.22
8. Total, synthesis gas -----	6.63

D. Cost of converting synthesis gas into primary product (synthetic petroleum), irrespective of the process by which the synthesis gas is obtained.—

Cost item:	Cents per gallon primary product
1. Operating costs	
a. Electric power.....	0.30
b. Water.....	0.02
c. Labor.....	0.80
d. Supervision.....	0.28
e. Miscellaneous.....	0.15
f. Catalyst regeneration.....	1.57
g. Total gross operating cost.....	3.12
h. Credit for steam.....	0.53
i. Total net operating cost.....	2.59
2. Capital cost (17 percent).....	3.76
3. Total, conversion cost.....	6.35

*E. Total cost of manufacture of Fischer-Tropsch primary product (synthetic petroleum).—*The total cost of making Fischer-Tropsch primary product will be the sum of the cost of the synthesis gas plus the conversion cost. These costs are therefore as follows:

	Cents per gallon from:		
	Coke	Sub-bituminous coal	Natural gas
Synthesis gas.....	12.24	7.25	6.63
Conversion cost.....	6.35	4.35	6.35
Total cost.....	18.59	13.60	12.98

Discussion.—The above costs per gallon of primary product of 18.59 cents from coke, 13.60 cents from subbituminous coal, and 12.98 cents from natural gas, are based on a plant making 2,424 barrels or 101,800 gallons of primary product per day, and are for pre-war conditions in the United States. These costs will doubtless be lowered appreciably by applying recent advances in the art, and by taking credit for chemical byproducts obtained.

In case the primary product is converted into gasoline by cracking and refining, there will result 1,940 barrels or 81,500 gallons of gasoline per day. The net conversion cost for cracking and refining would be \$964 per day or 1.18 cents per gallon of gasoline. The cost of gasoline by the Fischer-Tropsch process will therefore be as follows:

	Cents per gallon
From coke.....	24.4
From subbituminous coal.....	18.2
From natural gas.....	17.4

Steel requirements for Fischer-Tropsch process plant

The steel tonnage requirements for a plant of the above size would be as follows, based on data obtained in Germany, with some modification for American conditions. This is for a plant using coke as raw material.

Plant equipment:	Net tons steel
1. Water-gas plant:	
1. Structural.....	550
2. Reinforcing.....	900
3. Steel mesh.....	10
4. Plates.....	3,400
5. Piping and fittings.....	60
6. Cast iron.....	830
7. Nails and wire.....	30
Total.....	5,780 5,780

Plant equipment—Continued.

II. Conversion to synthesis gas and purification:		<i>Net tons steel</i>	
1. Conversion plant	-----	500	
2. Purification plant	-----	3, 630	
Total	-----	4, 130	4, 130
III. Fischer-Tropsch plant proper (conversion synthesis gas to primary product):			
1. Synthesis equipment (140 chambers)	-----	9, 850	
2. Coolers and absorption equipment	-----	2, 240	
3. Tanks and storage	-----	560	
4. Gas holders	-----	1, 050	
5. Feed-water equipment	-----	180	
6. Hydrogen plant (for catalyst)	-----	280	
7. Pipe lines	-----	1, 340	
8. Pipe supports	-----	280	
9. Fire equipment	-----	195	
10. Water lines	-----	225	
Total	-----	16, 200	16, 200
IV. Cracking plant and accessories	-----		1, 000
Grand total	-----		27, 110

This total steel required is equivalent to 14 tons of ordinary steel per barrel of gasoline produced per day. The amount of alloy steel needed for such a plant is insignificant.

Senator O'MAHONEY. Mr. Lowry, will you take the stand, please?

STATEMENT OF H. H. LOWRY, DIRECTOR, COAL RESEARCH LABORATORY, CARNEGIE INSTITUTE OF TECHNOLOGY, SCHENLEY PARK, PITTSBURGH, PA.

Dr. Lowry. Mr. Chairman, the Coal Research Laboratory was organized in 1930 to do fundamental research on coal and products derived from it, and continuously since September 1934 has included in its program of investigation a study of coal hydrogenation.

Senator O'MAHONEY. That is a branch of the Carnegie Institute of Technology?

Dr. Lowry. Yes. Another major project has been a study of the chemical nature of coal as a basis of increased use of coal as a raw material in the chemical industry. The hydrogenation work has been confined to a small-scale batch process and the objective has not been the production of motor fuel, but rather, an understanding of the initial liquefaction stage of the reaction between coal and hydrogen. My remarks are based on this experience, together with familiarity of the subject gained from knowledge of experimental work in laboratories in this country, Europe, and Asia, and from visits to coal hydrogenation plants in England and Germany in 1937.

Granting that coal will, in the not-too-distant future, necessarily become our source of motor fuel—possibly, the major one—it does not follow that the new industry in the United States should directly copy that in England or Germany. There is an enormous capital investment in this country in petroleum-refining equipment which should become an integral part of the new industry. In the direct coal-hydrogenation process, this could be accomplished by building plants to hydrogenate coal only to the liquid state, and this material then be supplied to petroleum refiners to carry it further to gasoline or intermediate stages instead of plants like the British and German, which

take in coal at one end and deliver gasoline at the other. This would seem to have many advantages, including full cooperation of the petroleum industry not only in refining but in distribution. It is my opinion that not enough experimental work has been done yet to feel assured that adequate knowledge is available for the most efficient design and operation of a coal-hydrogenation plant, limited to the liquefaction stage. Before authorizing construction of a full-scale plant, it would seem justifiable to recommend a large increase in the appropriation to the Bureau of Mines to permit construction and operation of several 100-pounds-per-day units for special investigation of the liquefaction stage of coal hydrogenation. If the experience of the British and Germans on hydrogenation of bituminous coals is applicable to American coals, this work should be done largely on those fractions of different coals which contain less than 2.5 percent ash.

Further investigation of the liquefaction stage is also desirable from the point of view of production of raw materials for the chemical industry, particularly the plastics industry. Commercial plastics are predominately of coal-tar origin. The growth of the industry has been such that additional sources of raw materials will be required. Coal tar is essentially a byproduct of the steel industry, which can hardly be expected to maintain its present high level of production of 90,000,000 tons a year following the war. Yet, the production of synthetic organic resins, according to the United States Tariff Commission, increased from over 213,000,000 pounds in 1939 to about 438,000,000 pounds in 1941 and in the latter year, 86 percent of the tar acids and 66 percent of the naphthalene went into production of plastics and nylon. It appears that the future growth of the plastics industry will be limited by the availability of raw materials unless another source is found. One such source is coal hydrogenation since the Bureau of Mines has reported a yield of phenol and its homologues 10 times as great by hydrogenation of coal as obtained by carbonization of the same coal. It is not now known whether this factor of 10 might not be increased to 20 or 30, and this problem should be investigated further in pilot-plant stage; the results might well change the economy of the process and decrease the cost of motor fuel obtained in subsequent operations.

The Fischer-Tropsch process does not seem to me to justify in our economy a similar position to that it holds in Germany and Japan. In this process the carbon atoms, which in the coal are in ring structures, such as are desired in high-octane gasoline, are separated individually and then recombined into chains. Those chains which are in the gasoline range have a low-octane rating—40 to 50—and have to be reformed by cracking with about a 75 to 80 percent yield into structures similar to those originally destroyed in the coal. Fifty-five percent of the product from the conversion of the synthesis gas is water. The energy relations are unfavorable: In the first step energy is lost at high level in the water-gas reaction and that regenerated in the second stage is at a low level. I was informed by German engineers that one of the principal justifications for the use of this process in Germany and Japan is their limited reserves of sufficiently low-ash bituminous coals for direct hydrogenation; the United States reserves are not limited to any like extent. However, it may be concluded from the experience at Billingham that the difficulties of hydrogenating

even low-ash bituminous coals are far greater than those encountered with the higher-ash brown coals. The cheap high-ash German brown coals, which cannot be cleaned to an acceptable degree for direct hydrogenation, still can be used for water gas, the initial step in the Fischer-Tropsch process. One special feature of this process is the production of a superior Diesel fuel which may justify particular consideration. Another place where the process might well fit in with United States economy is in connection with manufactured gas in replacing gas oil now used for enriching water gas. If some modification of the process could be found to yield hydrocarbons containing principally five or less carbon atoms, direct enrichment of the water gas would be possible and the load factor on existing water-gas sets could be considerably increased. This would require further experimental work before a full-scale plant could be designed and operated and a considerable increase in the appropriation made to the Bureau of Mines for this purpose would seem justified.

In conclusion, it is my opinion that coal hydrogenation should be developed differently in the United States than in Germany and England to fit in with existing conditions of industry; and that further intensive and extensive experimental work on a considerable scale of operation should precede authorization of construction and operation of full-scale plants, which, if done now, would necessarily largely copy European practice.

Senator O'MAHONEY. Are there any questions?

(No response.)

Senator O'MAHONEY. Doctor, we are very grateful to you, sir.

Our next witness will be Dr. C. C. Wright, professor of fuel technology at the Pennsylvania State College.

**STATEMENT OF C. C. WRIGHT, PROFESSOR OF FUEL TECHNOLOGY,
PENNSYLVANIA STATE COLLEGE, STATE COLLEGE, PA.**

Dr. WRIGHT. Mr. Chairman, I think Dr. Gauger notified you that I, C. C. Wright, would testify in his place this afternoon.

Dr. Gauger has prepared a statement which is about 14 or 15 pages in length.

I might say before presenting this statement that we apparently misconstrued the purpose of the bill as it has been given here today. It was our conception that a number of plants were contemplated, which were to be used for demonstration and development work, and, naturally, for research work on the hydrogenation process in general, rather than the construction of a full-scale process, and so our remarks are predicated upon that fact that we interpreted the bill as indicating a number of plants would be scattered throughout the country.

Senator O'MAHONEY. Which, in your opinion, would be the better policy for Congress to follow?

Dr. WRIGHT. Well, in our opinion, a number of small plants in which more extensive research and development work was done would be more desirable.

Senator O'MAHONEY. Does your statement, or Mr. Gauger's statement, undertake to estimate the cost that would be involved in such a program?

Dr. WRIGHT. No; we didn't undertake that, sir.

Senator O'MAHONEY. If you care to make any suggestions to the committee later on, and send them to us in Washington, we will be very glad to receive them.

Dr. WRIGHT. Thank you; we will do that, sir.

(The statement of Dr. A. W. Gauger, director of mineral industries research, the Pennsylvania State College, State College, Pa., was read by Dr. Wright as follows:)

Mr. Chairman and gentlemen of the committee, I deeply appreciate your invitation to appear before you and to discuss the very important subject of converting solid fuels into liquid fuels. I regret my inability to meet with you, but I have prepared a statement which I am asking my colleague, Dr. C. C. Wright, professor of fuel technology at the Pennsylvania State College, to submit for your consideration. I know that Dr. Wright will be glad to answer any questions that you may wish to ask him.

Research on the high-pressure hydrogenation of American bituminous coals was started in the laboratories of the Mineral Industries Experiment Station of the Pennsylvania State College in November 1932 and has been continued up to the present time.

The laboratory at the Pennsylvania State College is the oldest in America for such studies and, with the exception of preliminary work done at the University of Washington by Dr. Wright, who established the Penn State Laboratory, was the first coal-hydrogenation laboratory in a public institution in America.

As your committee knows, there are two general methods for the production of motor fuel from coal. These are—

(1) The hydrogenation and liquefaction of coal by the modified Bergius process, involving treatment of coal with hydrogen at high pressure and temperatures. This produces motor fuel and fuel oil.

(2) The conversion of coal into water gas, a mixture of carbon monoxide and hydrogen and the subsequent catalytic conversion of this mixture into liquid products, known as the Fischer-Tropsch process.

The Mineral Industries Experiment Station has worked on certain phases of both of the processes. Unfortunately, we have been greatly handicapped by the meager funds that have been available to us for these studies.

Under the sponsorship of the National Research Council, National Bituminous Coal Research, Inc., and various coal operators of Pennsylvania, investigations have been conducted upon the ease and mechanism of coal hydrogenation and the suitability of American bituminous coals for use in the Bergius process. Coals from Pennsylvania, West Virginia, Virginia, Ohio, Kentucky, Illinois, Alabama, Washington, and Utah have been investigated. Studies have been made on various fractions of a number of coals to determine the effect of hydrogenation upon the petrographic constituents of coal of varying rank and of the various fractions of the same coal.

Studies of the mechanism of coal hydrogenation are being carried out at the present time through studies of the destructive hydrogenation of complex organic compounds similar in chemical structure to bituminous coal.

As a result of investigation over the past 11 years, the conclusion has been drawn that American coals are as satisfactory for hydrogenation purposes as are coals of any of the countries now engaged in the commercial production of gasoline by this process. Certain coals, because of their physical and chemical composition (petrographic constituents and rank), are more suitable for use in this process than are others, but the major differences lie primarily in the yields of the various liquid fractions secured. The ultimate selection of coals for commercial use will require that an economic balance be reached between the value of the hydrogenation products, the cost of conversion, and the initial cost of the coal.

For the production of gasoline of high quality there is no question but that high-pressure hydrogenation of American coals is technically feasible. Up to the present time no one has succeeded in producing a satisfactory Diesel oil or lubricating oil by coal hydrogenation, and from fundamental considerations of the chemical structure of these products and of coal, it appears extremely doubtful that any degree of success can be expected without a very involved chemical treatment which would rearrange the molecular structure of the products from coal. More recent information indicates that Germany is now producing Diesel fuels by blending hydrogenated products.

In 1934 I was in Germany and England and there I saw small samples of what purported to be lubricating oil. In England, strange as it may seem, they had more than in Germany, and the chief chemist of the English plant wrote me later that the samples they had were unsuitable as lubricating oil, and did not compare with the poorest lubricating oils of some time ago. Whether they have had more success later I do not know.

These studies relate to the direct hydrogenation of coal. Our work on the second method, namely, the Fischer-Tropsch process, has been concerned almost entirely with the first step, which is the production of water gas. A very extensive investigation of the production of water gas from anthracite has been completed and the results are available in publications of The Experiment Station. A list of these and other pertinent publications is appended to this statement.

Gentlemen, you have under consideration a matter which is of vital concern to these United States of America. Since World War I we have become a nation on wheels. Should I ask any one of you what rationed article is the most sensitive to public reaction, I am sure the answer would be gasoline. It so happens that we have been generously endowed with petroleum, which has been the source of our liquid fuels and lubricants. However, petroleum, like other minerals, is nonreplaceable. When once used it is gone. We have been using this resource at a tremendous rate during the past several decades, but new discoveries and recovery techniques have enabled us to keep the known reserves in step with the withdrawals. True, from time to time we have had scares and threats of shortage, but the fact that the scarcities have never materialized has brought about a certain complacency and a feeling that this is another cry of "Wolf, wolf." However, it will be recalled that in the fable the wolf finally did arrive, with disastrous consequences. We are now in the midst of a struggle for our very existence and it behooves us as intelligent citizens to examine the situation carefully, lest the same fate overtake us.

Summed up briefly, petroleum technologists are agreed that petroleum is being consumed at an alarming rate and new discoveries are not keeping pace. The needs for oil under present trends of consumption will require that 50 to 60 billion barrels be found during the next 20 years to maintain present ratios of reserves to consumption. This is as much as has been discovered since the oil industry was founded 80 years ago.

So much for our needs; what of the present rate of discovery? The alarming feature is that it now requires three times as much drilling to find a new barrel of oil as it did 5 years ago. In other words, while the annual number of wildcat wells has increased, and the number of discoveries has been greater, the size of the fields and the total amount of oil discovered has averaged less.

No one can say with certainty, prior to drilling, where oil will be found, and new discoveries will no doubt be made. However, the probability of finding large new fields is decreasing with each new discovery. The acceleration of use resulting from the wartime needs has hastened the day of reckoning.

The Mineral Industries Experiment Station has pioneered in research on secondary methods of recovering petroleum and we are acutely aware of the present situation. It is for this reason that we are favorable to all intelligent, efficient, and economical methods of attacking the problem of insuring our citizens of an adequate supply of motor fuel.

We have studied Senate bill 1243 carefully and it is my wish to speak particularly to two points. The first of these is paragraph (d) of section 2, which reads in part as follows: "To cooperate with any other Federal or State department, agency, or instrumentality, etc."

I trust that this really means what it says and I offer the facilities and staff of the mineral industries experiment station for the purpose. We have already offered our facilities and service to many branches of the Federal Government, but little avail has been made of this offer. Instead there has been a growing tendency to create new laboratories and agencies and to seek our men and men from other State or private organizations to man them. This process inhibits instead of accelerates progress and is at best a costly, wasteful procedure.

The Pennsylvania State College is the land-grant institution of Pennsylvania. It is the oldest of such institutions and was founded for just such purposes as are exemplified in the subject under consideration today. Failure on the part of Federal agencies to use it as well as other land-grant institutions of the country to the fullest extent has been, in my estimation, a reflection of shortsightedness on the part of those in active conduct of the war effort. This is a

war of wits and we need to mobilize our full technologic resources if we are to win it quickly. This, in my opinion, has not been done.

Permit me now to discuss the location of demonstration plants. Such plants should be of both the Fischer-Tropsch and Bergius types.

In the location of such plants two general factors, and only two, are of paramount importance. The first of these is the supply of raw materials, including coal, power, and water. The second factor is the proximity to the consuming market for liquid fuel. In respect to both of these factors, Pennsylvania stands preeminent as a logical location for such plants. Her coal supplies are enormous and varied, her water and power supplies are ample and good, and she is in the midst of that part of our land that is in dire need of additional supplies of motor fuel.

Pennsylvania's coal resources range from the low-volatile anthracite through the various ranks of bituminous coal to the type known to scientists as high-volatile A. Three fuels are available for the Fischer-Tropsch process, anthracite, bituminous coal, and coke, all produced in Pennsylvania and all near the consuming market. The Congress has already shown its concern in the future of the anthracite region by the appointment of an Anthracite Economic Investigating Commission and the passage of a measure authorizing the establishment of an anthracite research laboratory.

Anthracite cannot be used for the production of byproducts as is the case with bituminous coal. It is, however, a very fine fuel for generation of water gas which can be used as the basis of certain chemical industries of which the Fischer-Tropsch synthesis of motor fuel is one example. Let me quote from the recommendation of the Federal Anthracite Coal Commission, House Document No. 709.

"By suitable operation of the generator, and subsequent treatment of the water gas, it is possible to produce hydrogen to be used in ammonia synthesis. The location of synthetic ammonia plants in the region would be desirable, since they would utilize directly some of the unemployed labor, would consume anthracite as fuel for water-gas generation, and would eliminate the necessity for building expensive coke-oven plants with their heavy demand for steel and other vital materials. Within or near the anthracite region is the only location at which synthetic ammonia plants could be operated economically without coke ovens when solid fuels are to be used."

What is true of ammonia is equally true of the Fischer-Tropsch synthesis. The Pennsylvania anthracite region, situated as it is within 125 miles of the metropolitan areas of New York and Philadelphia, with ample raw material supplies, and with a wealth of basic information on the generation of carbon monoxide and hydrogen from anthracite, offers an unparalleled location for a pilot plant on the Fischer-Tropsch process.

The industry has a lively interest in such developments as is evidenced by the following resolution adopted by its research advisory committee at a meeting in Wilkes-Barre on July 23, 1943.

"Whereas there is now before the Congress Senate bill 1243, authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal; and

"Whereas one process of producing such liquid fuels is by catalytic synthesis from carbon monoxide and hydrogen; and

"Whereas anthracite has been demonstrated to be an excellent raw material for production of carbon monoxide and hydrogen by reaction with steam in the water-gas generator; and

"Whereas ample supplies of water and power are available for such a process in the anthracite region: Be it now

"Resolved, That the merits of anthracite for purposes of making liquid fuel be brought to the attention of the Senate Committee on Public Lands and Surveys; and further be it

"Resolved, That the Senate Committee on Public Lands and Surveys be urged to consider favorably the establishment of a Fischer-Tropsch demonstration plant to produce synthetic liquid fuel from anthracite and other substances in the anthracite region of Pennsylvania."

To turn now to the Bergius process. The Commonwealth of Pennsylvania can again supply the necessary raw materials and favorable location with respect to the market for a demonstration plant. The bituminous coal fields cover an area of roughly 14,000 square miles in the central and western part of the State. Within this region are found all ranks of coal, beginning with high volatile A, containing 40 percent volatile matter and continuing upward to low volatile bituminous coal, containing 15 percent volatile matter.

Some of these coals have already been tested in batch and continuous small-scale hydrogenation experiments. Unquestionably most, if not all, of them will prove to be satisfactory raw materials for hydrogenation if the correct conditions are worked out.

The Mineral Industries Experiment Station early showed that certain petrographic components which make up the coal are more suitable for hydrogenation than others. Thus fusain and opaque attritus are extremely difficult to hydrogenate, whereas anthraxylon and translucent attritus hydrogenate with ease.

Reports on German practice indicate that it is now customary to separate the coal into its three main petrographic components and to apply each to the purpose for which it is best suited.

The Mineral Industries Experiment Station has also conducted some work on two alternative methods for the primary liquefaction of coal, which, although not carried beyond the laboratory stage because of the limited funds available, are nevertheless worthy of consideration.

In the first of these the investigations were on extraction hydrogenation, using solvents such as tetralin and related compounds, which serve as hydrogen carriers. Such processes can be carried out at medium pressures and temperatures and appear to give higher conversions of the coal than do the normal high-pressure, high-temperature processes. It is reported that two such processes are now being used successfully in Germany. Considerable experimental work remains to be done on this phase of coal liquefaction.

The second alternative is pretreatment of the coal to make the coal substance more amenable to hydrogenation while at the same time removing the inert constituents—mineral matter and fusain. Methods for the preparation of an ash-free coal have been extensively investigated at the Mineral Industries Experiment Station and have resulted in the Fuchs patent, United States Patent No. 2,242,822. Other applications are pending.

The process involves oxidation of the coal substance to convert it into material soluble in furfural and related solvents. The insoluble mineral matter and fusain can readily be separated from the soluble coal, and the latter recovered from solution by various methods, or hydrogenated directly. If hydrogenated directly at low temperatures and pressures in the presence of suitable catalysts, a product results which is a liquid of reasonably low viscosity even when highly concentrated. This concentrated solution may be suitable for direct use as an ash-free fuel in burning equipment, for processing into Diesel fuel or colloidal fuel, or may serve as the raw material for further hydrogenation to produce other liquid products.

From the long-range viewpoint it would appear highly desirable that research and development work be actively promoted by the Federal Government on alternative possibilities for the primary liquefaction of coal. It is a well-recognized fact that neither of the major processes for producing gasoline from coal is economic in competition with petroleum products under existing conditions. The day will come, however, when we may have to rely upon coal to fulfill our needs, and it behooves us to explore all possibilities thoroughly, while time remains, so that the citizens of this country will be assured not only of an adequate supply, but also that this supply will be produced at the lowest possible cost and with the minimum drain upon natural resources.

The diversity of the coal deposits in Pennsylvania, the ample supplies of water available, the presence of many oil refineries, and the proximity to market for the final products are all factors that favor the establishment of demonstration plants in this State.

In conclusion, Mr. Chairman and gentlemen of the committee, may I compliment you on this evidence of foresight. I commend to your careful consideration the establishment of at least two types of demonstration plants in Pennsylvania for converting solid fuels into liquid fuels and the active promotion of investigation on alternative methods for the primary liquefaction of coal. Finally I offer you the cooperation of the Mineral Industries Experiment Station laboratory at the Pennsylvania State College.

Senator O'MAHONEY. Thank you very much.

Are there any questions?

(No response.)

Senator O'MAHONEY. Thank you very much, sir.

Mr. Richard Maize is here representing Governor Martin of Pennsylvania.

You may go ahead, Mr. Maize.

STATEMENT OF RICHARD MAIZE, SECRETARY, STATE DEPARTMENT OF MINES, HARRISBURG, PA.

Mr. MAIZE. Mr. Chairman and gentlemen of the committee, the Governor had hoped to be here, but previous commitments made it impossible, and he asked me to extend to the committee his regrets.

Senator O'MAHONEY. We recognize the pressure under which the Governor is working.

Mr. MAIZE. I am going to submit a short statement and later supplement it with a few remarks. It will not take very long.

You have before you for consideration a subject that is of far-reaching significance to this Nation, namely, the task of insuring to our citizens a continuing future supply of motor fuel and other materials now being obtained from natural petroleum, should the reserves of this raw material fail to keep pace with the demand.

As all of you are aware, beginning with the early experiments of the Pennsylvanian, Samuel Kier, and the drilling of the Drake well near Titusville in 1859, the Commonwealth of Pennsylvania has pioneered in the development of techniques of oil recovery and processing. We are still pioneering in such developments, and our oil fields, though frequently considered to be exhausted, are still producing, by secondary methods of recovery, many barrels of that premium product, Pennsylvania grade crude oil.

In this day of mechanized warfare, with its airplanes, tanks, and other motorized equipment, it is indeed fortunate that Pennsylvanians have used their ingenuity in the constant development of new methods of recovery of petroleum from the earth.

Pennsylvania not only has oil but it has coal as well. It has the only important deposits of anthracite coal found in these United States, and it has vast resources of high-grade bituminous coal, ranging in volatile matter content from 15 to 40 percent. It is my understanding that by using different processes of producing liquid fuels both bituminous coal and anthracite can serve as raw materials.

It so happens that these large reserves of solid fuels, which in the past have been the bulwark of the industrial development of our State and Nation are ideally situated, by virtue of their proximity to the eastern markets, where the peacetime consumption of liquid fuels and lubricants is large and the present shortage of gasoline and fuel oil is most acutely felt.

With ample supplies of water, plentiful labor, enormous reserves of anthracite and bituminous coal of different grades, and its splendid geographic location with respect to markets, Pennsylvania presents ideal conditions for location of demonstration plants for production of liquid fuels and other products, both by synthesis from carbon monoxide and hydrogen, and by direct hydrogenation of bituminous coal.

However, not only does Pennsylvania present the necessary ingredients for successful experimentation along these lines but it also has the interest and skill of new scientific and engineering endeavor. This is evidenced by the fact that the Commonwealth has established an experiment station in connection with its school of Mineral Industries at the Pennsylvania State College which is pioneering in mineral technologies and has been engaged for 12 years in research on many phases of

problems facing the mineral industries. With State and industrial support, it has conducted extensive researches on anthracite and bituminous coal, many of which are directly concerned with or closely related to coal liquefaction.

I cannot emphasize too strongly that Pennsylvania offers the one ideal opportunity for demonstration plant experimentation for all processes of production of liquid fuels from coal now known, and I pledge the cooperation of the State's mineral industries experiment station in this effort. In the future, as in the past, the resources of Pennsylvania and the resourcefulness of Pennsylvanians are available to these United States.

Supplementing the statement I have just read, Pennsylvania has been the pioneer in the development of crude oil; and in listening to this discussion it appears to me that the hydrogenation of coal to produce the liquid fuels is only in the experimental stage. It is going to take a long time before we produce liquid fuels in commercial volume sufficient to replace or take up the loss that is going to happen as the result of a depletion of the natural crude oils. In this connection it appears to me that it is a shame to burn crude oil for heating purposes. The Pennsylvania School of Mineral Industries has developed a process of liquefying coal which can be burned as a liquid instead of using the present crude oil. In that way at least we will save a large amount of oil that is being used now for heating purposes that could be supplied by this process as developed by the School of Mineral Industries of the State College.

Senator O'MAHONEY. At what cost would the liquefied coal be produced?

Mr. MAIZE. I don't know what the cost would be, Senator. Dr. Wright made mention of this process on page 10 of his paper. It is known as the Fuels patent. I am not in a position to say just exactly what the cost would be, but I feel that it could be produced at a cost comparable at least with the fuel oil that is being used for domestic purposes at this time. Dr. Wright can probably answer those questions better than I can.

I am just mentioning that fact to show that there is a possibility of taking care of this gradual reduction of the crude oil by using the liquefied coal in its place until at least this hydrogenation process reaches the point where it can produce the necessary fuels at a reasonable cost.

Senator O'MAHONEY. Any questions?

(No response.)

Senator O'MAHONEY. We are very grateful to you, Mr. Maize, and grateful to the Governor for sending you.

Mr. MAIZE. Thank you.

Senator O'MAHONEY. Dr. Leighton.

STATEMENT OF M. M. LEIGHTON, CHIEF, ILLINOIS STATE GEOLOGICAL SURVEY, URBANA, ILL.

Dr. LEIGHTON. Mr. Chairman and members of the committee, if I have heard correctly, I believe that I am the only one here from the Middle West.

Senator O'MAHONEY. Yes. You are representing Illinois.

Dr. LEIGHTON. Consequently, I feel highly flattered that I should be asked to come to this hearing. I feel that I have been in splendid company here today, and I feel at home, inasmuch as I know practically all of the witnesses who have submitted testimony. I am greatly interested in the views that have been presented.

We have looked at this matter from the standpoint of the economics of the upper Mississippi Valley States; consequently, some of the statements that I shall make are based on a little different viewpoint than what has been presented so far today.

The following testimony is submitted for the purpose of showing the need of such demonstration plants as are proposed in this bill by setting forth some of the important conditions prevailing in Illinois and other upper Mississippi Valley States with respect to the volume of their liquid-fuel requirements, the present petroleum reserves, and the resources of coal which are potentially capable of being diverted into liquid fuels in large quantities.

I wish to state my summary of conclusions, that you may get the high lights first, and then discuss very briefly some of the points.

1. The upper Mississippi Valley States, including Illinois, Indiana, Iowa, Michigan, Missouri, Minnesota, and Wisconsin, are of extreme importance in our national economy. They contain 22 percent of the population of the United States, produce 28 percent of the Nation's manufactured products and 30 percent of the Nation's agricultural products.

2. These States consume 15 percent of the fuel oil, 16 percent of the kerosene, 26 percent of the gasoline, and 33 percent of the tractor fuel output of the Nation.

3. These large liquid-fuel requirements are essential in our present economy not only to this area but also to the entire Nation.

4. The present established petroleum reserve and the expected rate of petroleum discovery are inadequate to support requirements at the current level for any extended period of time.

5. The crude-oil reserves most readily available for the oil requirements of the upper Mississippi Valley are estimated at 13 percent of the national total, whereas production from these reserves is 27 percent of the national total.

6. The eastern interior coal basin of Illinois, Indiana, and western Kentucky contains reserves of low-cost coal adequate for over a thousand years' demand.

7. These coals are principally of high-volatile bituminous B and C rank, which are well adapted for conversion into liquid fuels and oils by hydrogenation.

8. A modernly equipped coal mining and preparation industry is functioning well in this area, producing one-ninth of the Nation's coal supply at low cost and at the lowest man-hour per-ton rate of any major coal field in the United States.

9. Common sense dictates that a commercial scale experimental plant for the conversion of these coals into liquid fuels and oil by hydrogenation be put into production in this area as promptly as possible in order to assure a continuing supply of the necessary liquid fuels and oil to our Nation.

Now, let me speak for just a minute on the liquid fuel requirements of the upper Mississippi Valley States.

The upper Mississippi Valley States comprise an area of great importance from the standpoint of both manufacturing and agriculture, and this district has a population of nearly 29,000,000 people. Twenty-eight percent of the value of the manufactured products of the Nation come from this area, this value amounting to nearly \$16,000,000,000 according to the 1939 census—table 1.

The value of the agricultural products amounts to \$2,333,000,000, or 30 percent of the national total as of 1939—table 2. This is an area where farm operations have been geared to the use of power equipment and large machine operations. Therefore tractor fuel is an important element and this must be provided for in the future development of this area.



FIGURE 1.—Map of Illinois, Indiana, and western Kentucky coal fields showing (in black) the extent of the main mining districts.

The fuel oil consumed by the manufacturing industries in the principal industrial districts—Chicago, Detroit, St. Louis, Milwaukee, Minneapolis, and Indianapolis—is 18,000,000 barrels, or one-seventh of all the fuel oil that is used in the Nation.

The number of workers in these industrial districts is over 1,500,000, or one-seventh of the total workers of the United States—table 3.

One-fifth of the total oil products requirements of the Nation, almost one-fourth of the national gasoline, and one-third of the national tractor fuel, are consumed in this area. These requirements will grow. Table 4 gives the consumption of liquid fuels in the upper Mississippi Valley States in 1940 and population data.

Limited nature of crude oil reserves available to this area: Crude-oil supplies for the upper Mississippi Valley are obtained in the main

from midcontinent sources. The State of Illinois, the largest oil producer in the upper Mississippi Valley, now contributes less than 40 percent of the market requirements of this area—table 5.

More significant than the inadequate local production to meet market requirements is the limited known reserves in the States from which the oil supply for this area is now drawn. Under current production levels, the ratio of production to reserves in those States which mainly supply the upper Mississippi market area is only 1 to 7.8, whereas for the Nation as a whole the ratio is 1 to 15—table 6. The reserve picture for the consumers of the upper Mississippi Valley States is thus shown to be critical.

It may be suggested that inadequacy of oil reserves in midcontinent States for the requirements of refineries in the upper Mississippi Valley may be met by shipments from Texas. But it must be pointed out that the refineries in the Gulf coast and on the Atlantic seaboard are also competing for dwindling reserves. The Gulf coast very obviously has an advantage in lower transportation costs and the Atlantic seaboard may regain its former transportation advantage upon return to local tanker movements, even though a large pipe line now connects Texas with southern Illinois. Although this requires further examination into comparative transportation costs under conditions that will prevail in the post-war period, it is certain that the upper Mississippi Valley States will enter into increasingly vigorous competition with consumers on the Gulf coast and on the Atlantic seaboard for the backlog of reserves in Texas.

This all appears to me to show that the present proven reserves and the current rate of discovery are entirely inadequate to maintain present production levels. Discoveries during the next decade in the amount of 15,000,000,000 barrels of oil will probably be required to meet expected needs. During the past 9-year period ending 1942 only an average of $1\frac{1}{3}$ billion barrels were discovered, and during the past 5-year period ending 1942 less than a billion barrels per year. With present demand at about 1.4 billion barrels per year, it is evident that our rate of discovery is far below current consumption.

Alternative sources of liquid fuel: Regardless of the fact that a portion of the fuel requirements heretofore provided for by low-priced petroleum and petroleum products will be replaced by solid fuels, there are, however, certain very large fuel requirements under our present economy that can be met only by the use of liquid fuels. These requirements range from the utterly indispensable needs of liquid fuels for the armed forces to the highly convenient, indeed necessary, use of liquid fuel for automobiles, motor transport, and farm tractors. Because our national safety and independence requires that we be largely free from dependence upon oil fields under foreign sovereignty, the continued production within the borders of the United States of a substantial portion of our liquid fuels is absolutely imperative.

In the upper Mississippi Valley area the most logical source of all raw material for conversion to liquid fuels is the extensive coal beds of the eastern interior field and the western interior field.

I call your attention to these two fields, if I may. This one here [indicating] being the eastern interior field, and this [indicating] being the western interior field.

Senator O'MAHONEY. For the benefit of the record, Dr. Leighton, will you please indicate the States to which you have just pointed on the map, otherwise it will not appear on the record, you see.

Dr. LEIGHTON. The eastern interior field covering an area in Illinois, Indiana, Kentucky; the western field extending from north-central Iowa through northwestern Missouri, eastern Kansas, north-eastern Oklahoma, into northern Texas.

Senator O'MAHONEY. Thank you.

Dr. LEIGHTON (continuing). Because the eastern interior field contains the greater coal resources, and because I am more familiar with it, I shall devote myself herein to that field.

The eastern interior field comprises about 35,000 square miles in Illinois, 6,500 square miles in Indiana, and 5,000 square miles in western Kentucky and contains reserves sufficient for more than a thousand years. The late M. R. Campbell, of the United States Geological Survey, estimated that this field contains 250,000,000,000 tons, most of which is classified as high-volatile bituminous group C or group B coal. No other coal field in the country contains a quantity of coal classified in these groups more than remotely approaching the quantity in the Illinois and Indiana coal basins.

The character of the coal in most of this large area, mainly represented by five or six widespread workable beds, is very uniform. Experimental assay tests on the hydrogenation of coals ranging from lignite to high volatile A bituminous coal at the United States Bureau of Mines experiment station in Pittsburgh, Pa., indicate that the high volatile B and C bituminous coals tested are well adapted for use in the hydrogenation process for the production of liquid fuels, tar acids, and aromatic compounds for the chemical industries. Although the midwestern coals of Illinois, Indiana, and western Kentucky are principally high volatile B and C bituminous coals, Illinois coal No. 6 from Franklin County, which is a high volatile B bituminous coal, is the only one from this midwestern district which has been tested by the Bureau of Mines. This coal compares very favorably with others assayed by the hydrogenation process. The distribution of the mines in Illinois is shown in figure 2.

The coal-mining industry of this district is, on the whole, unusually well equipped with modern appliances for mining and for coal preparation. In Illinois there are 234 (1939) operations, each of which produces more than 10,000 tons annually, and in Indiana 116 such operations. I do not have similar figures for western Kentucky. It is probable that many of these mines with slight adjustment could prepare coal to meet special specifications of ash or sulfur content, or of the physical ingredients of the coal with respect to size and physical constitution.

The costs of mining are low. The Bituminous Coal Division of the United States Department of the Interior, in a preliminary summary

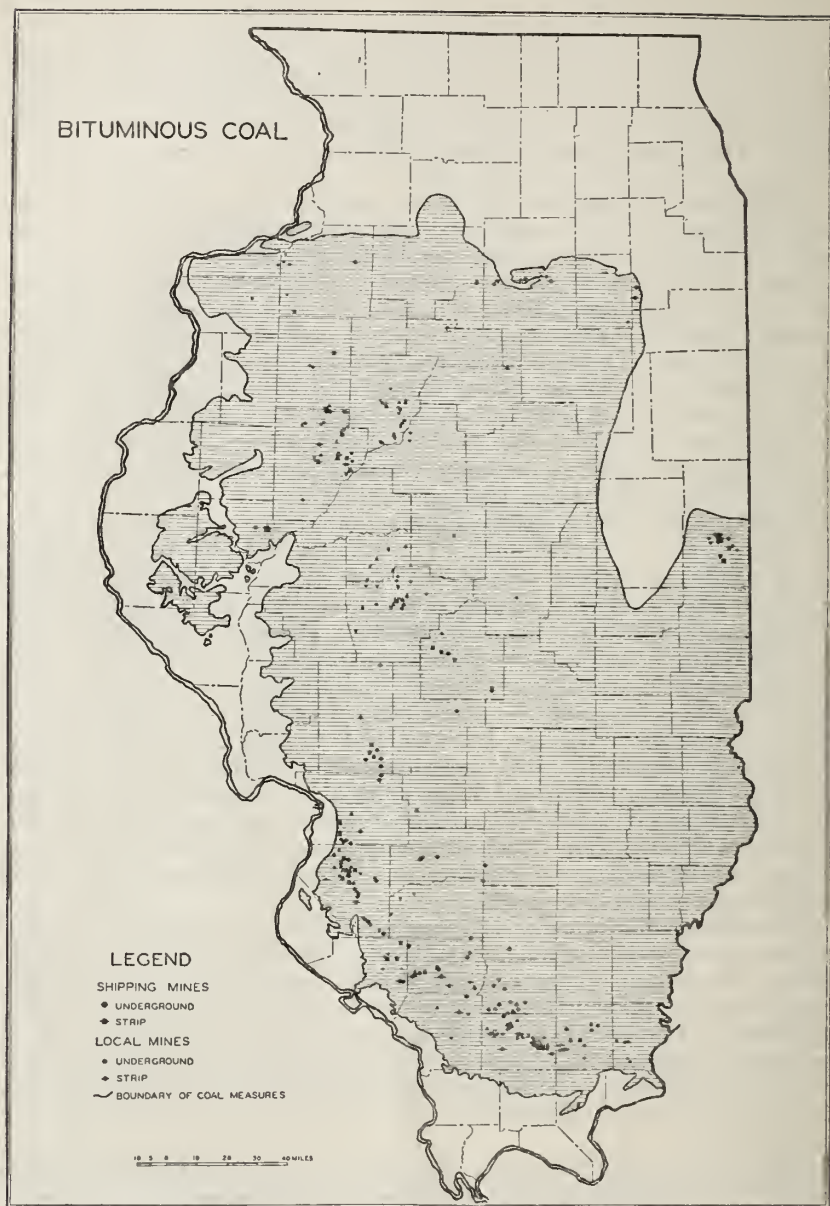


FIGURE 2.

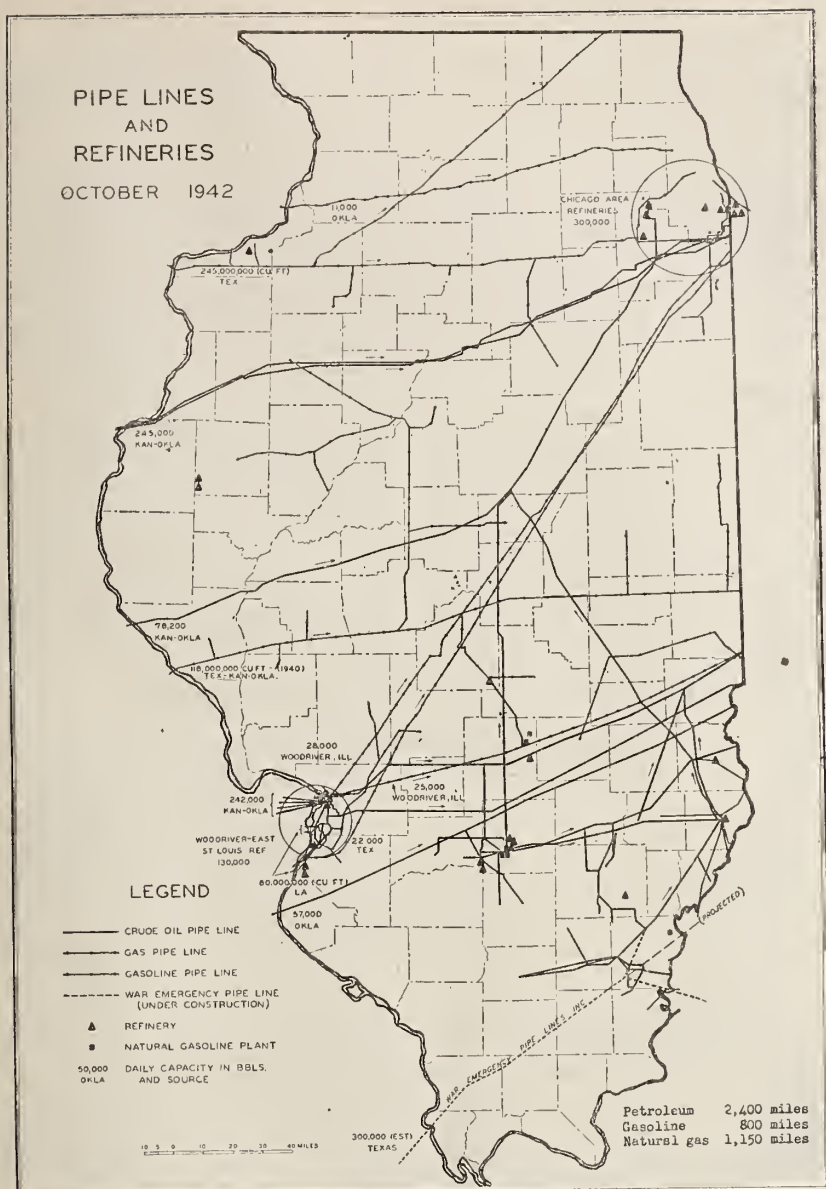


FIGURE 3.

report of costs and production tonnage for the year 1940, gives the following calculations for the eastern interior basin:

Producing district	Total tons produced	Total producing administrative and selling costs	Per ton
Western Kentucky.....	6,396,720	\$8,968,507	\$1.4020
Illinois.....	49,067,673	77,776,922	1.5851
Indiana.....	16,559,314	23,562,365	1.4229

The mining efficiency is high. The output per man per day is the highest in this coal field of all the larger producing fields (table 7).

Existing transportation systems are adequate for the movement of large tonnages of raw materials and liquid fuel products irrespective of plant location. Existing pipe lines now carrying crude petroleum originate in several localities in the Illinois Coal Basin and terminate in both the Chicago and St. Louis districts (fig. 3). Interstate pipe lines also connect Illinois with southwestern States and the eastern seaboard.

All of these conclusions lead unmistakably to one conclusion—namely, that the upper Mississippi Valley States are facing an immediate future which definitely requires aggressive research by development plants on the production of liquid fuels and oils by hydrogenation of the coal resources residing therein. Moreover, it is equally apparent that special and ample attention can be given these coals for hydrogenation purposes only in their own locality, which region lies in the center of the continent, far removed from shore lines or other positions of accessibility to any attack by a foreign power.

Thank you.

(The tables submitted by Dr. Leighton are as follows:)

TABLE 1.—*Value of manufactured products for States of the upper Mississippi Valley and United States total (1939 census)*

State:	Value in thousands
Illinois.....	\$1,794,861
Indiana.....	2,227,648
Michigan.....	4,348,223
Wisconsin.....	1,604,507
Minnesota.....	845,772
Iowa.....	718,532
Missouri.....	1,388,056
Total.....	15,927,399
United States.....	56,843,024
Percent of United States.....	28.0

TABLE 2.—*All farm products sold, traded, or used by farm households, 1939*

Illinois.....	\$454,583,861
Indiana.....	247,045,839
Michigan.....	209,720,223
Wisconsin.....	277,746,723

TABLE 2.—*All farm products sold, traded, or used by farm household, 1939—Con.*

Minnesota.....	\$344, 075, 858
Iowa.....	561, 836, 688
Missouri.....	261, 836, 589
Total.....	2, 376, 845, 781
United States.....	7, 813, 644, 567
Percent of United States.....	30. 1

Source: United States Census on Agriculture.

TABLE 3.—*Number of workers in the industrial districts of the upper Mississippi Valley States*

Industrial district:	Persons employed
Chicago.....	656, 337
Detroit.....	408, 200
St. Louis.....	168, 782
Milwaukee.....	134, 309
Minneapolis-St. Paul.....	68, 715
Indianapolis.....	53, 509
Kansas City.....	53, 085
Total, upper Mississippi Valley.....	1, 543, 017
Total United States.....	10, 414, 764
Percent of United States.....	14. 8

TABLE 4.—*Consumption of liquid fuels in the upper Mississippi Valley, 1940*

[In thousands of barrels]

	Population	Gasoline	Kerosene	Fuel oil	Traetor fuel ¹	Total
Illinois.....	7, 897, 241	35, 944	3, 069	26, 182	340	65, 195
Indiana.....	3, 427, 796	17, 175	1, 558	9, 965	168	28, 698
Michigan.....	5, 256, 106	29, 979	1, 226	11, 957	136	43, 162
Wisconsin.....	3, 137, 587	14, 049	912	6, 885	208	21, 846
Minnesota.....	2, 792, 300	13, 861	997	6, 939	262	21, 797
Iowa.....	2, 538, 268	13, 637	1, 132	3, 449	282	18, 218
Missouri.....	3, 784, 664	16, 623	1, 190	10, 404	157	28, 217
Total.....	28, 904, 062	141, 268	10, 084	75, 781	1, 553	227, 143
United States total.....	131, 669, 275	574, 420	67, 662	498, 475	4, 683	1, 131, 557
Percent of United States total.....	22. 2	24. 6	14. 9	15. 2	33. 2	20. 1

¹ Included with kerosene in making up the total.

Source: Bureau of Mines, Mineral Yearbook, 1941.

TABLE 5.—*Receipts of crude oil by refineries in the upper Mississippi Valley, 1940*

[Thousands of barrels]

From—	To—					Total
	Illinois	Indiana	Michigan	Missouri	Kentucky	
Illinois.....	51, 030	13, 154	5, 714	115	5, 679	75, 692
Kansas.....	2, 208	17, 996		2, 051		22, 255
Louisiana.....	217					217
New Mexico.....	4, 507	521				5, 028
Oklahoma.....	9, 018	33, 396	391	3, 500	177	46, 482
Texas.....	6, 031	5, 642		438		12, 111
Other.....	807	4, 146	18, 247	2, 300	7, 324	32, 824
Total.....	73, 818	74, 855	24, 352	8, 404	13, 180	194, 609

Source: Bureau of Mines, Minerals Yearbook, 1941.

TABLE 6.—*Production in 1942 and reserves as of Jan. 1, 1943, of upper Mississippi Valley States*

[In thousands of barrels]

	Production ¹	Reserves ²	Ratio of reserves to production
Illinois.....	106,456	469,789	4.4
Indiana.....	6,743	32,630	4.8
Kansas.....	97,636	896,819	9.2
Kentucky.....	4,472	42,313	9.4
Michigan.....	21,754	77,861	3.9
Oklahoma.....	140,690	1,121,226	7.9
Total.....	377,751	2,640,647	7.8
Total, United States.....	1,385,479	20,675,899	14.9
Percent of United States total.....	27.2	12.8	-----

¹ Monthly Petroleum Statement, December 1942, Bureau of Mines.² Oil and Gas Journal, Jan. 28, 1943, p. 65.TABLE 7.—*Output per man per day tons of coal produced on active days, per man shift, 1939*

Alabama.....	3.16	Kentucky.....	4.68	Pennsylvania.....	4.77
Illinois.....	7.98	East.....	4.43	West Virginia.....	5.51
Indiana.....	9.79	West.....	6.09		
Iowa.....	3.20	Ohio.....	5.35		

Source: Minerals Yearbook, 1941, pp. 868-881.

Senator O'MAHONEY. Are there any questions?

Congressman KELLEY. I have one question, if I may, of Mr. Maize. As a matter of comparison, do you have the cost in mind of bituminous coal in Pennsylvania?

Mr. MAIZE. Well, I just made a little notation here: The average cost is about \$2.50 per ton, and, according to the figures just submitted, about \$1.40 in Illinois.

Dr. LEIGHTON. The cost of mining in the various States is given in the Preliminary Summary Report of Costs and Production Tonnage, issued by the Bituminous Coal Division, United States Department of the Interior, for the calendar year 1940, based on reports of producers on Cost Form No. 4 and Form T-2.

Senator O'MAHONEY. All of these tables will appear in the record. Are there any other questions?

(No response.)

Senator O'MAHONEY. Very well, Dr. Leighton; we are very grateful to you.

Mr. Eavenson.

STATEMENT OF HOWARD N. EAVENSON, PRESIDENT, BITUMINOUS COAL RESEARCH, INC., PITTSBURGH, PA.

Mr. EAVENSON. My name is Howard N. Eavenson. I live in Pittsburgh, Pa., and am a consulting mining engineer, specializing in coal, with the firm of Eavenson, Alford & Auchmuty. I am president of Clover Splint Coal Co., Inc., operating in Harlan County, Ky., and actively interested in the management of two other coal companies. I am president of Bituminous Coal Research, Inc., which is the research instrumentality of the bituminous-coal industry, and am connected

with the activities of the coal research laboratory of Carnegie Institute of Technology.

I am heartily in favor of the purposes of the bill, S. 1243, in building test plants to produce liquid fuels from both bituminous coal in its broadest sense, and oil shale. While the possibility of producing liquid fuels from both these substances is definitely known, we need to know the amounts that can be produced from the various beds and what the cost of production will be. Plants to be built under the provisions of this bill should be large enough to demonstrate those facts but not too large for test purposes. It would seem advisable that one such plant for coal should be located available to the coals east of the Mississippi, and one west of that stream, and the plant to test oil shale should be in Colorado or Utah.

Before any of these plants are built, all available information should be obtained from companies or individuals who have been investigating these processes in recent years. I understand that at least one of the large oil companies—and probably more—have made extensive researches and experiments on producing liquid fuel from coal, and less extensive work has been done on the oil shales.

I am strongly opposed to carrying these tests any further than the production of a base liquid fuel from either coal or shale.

We have a tremendous oil-refining industry in this country, exceedingly well equipped in every respect for investigating, refining, and shipping any final products that may be made from coal or shale, and there is no necessity to duplicate any of this equipment. Certainly the oil industry will be deeply interested in the results of these demonstrations and will be most cooperative.

I would suggest that in the design and location of these test plants advisory committees from the oil-refining industry and the coal industry be formed, the former to be consulted about the technical details of the process and the latter about the kinds, amount, and costs of the various coals available.

The data derived from tests of this sort would be enough to determine the kind and size of commercial plants to be built and what the final cost of the products would be.

Senator O'MAHONEY. What do you mean by the base liquid fuel?

Mr. EAVENSON. I mean that when the coal is in a liquid state that it ought to be turned over then to the present existing refineries who do that business now.

Senator O'MAHONEY. You do not mean to limit it to those now in the business?

Mr. EAVENSON. No; I mean the oil-refining business.

Senator O'MAHONEY. Are there any other questions?

Congressman KELLEY. I have one, Mr. Chairman.

Senator O'MAHONEY. Congressman Kelley.

Congressman KELLEY. Mr. Eavenson, you have had a wide experience as a mining engineer and in research work. Is it your opinion that now is the time for the Federal Government to assist in the experimental work in order to supplement in part the loss due to fuel oil?

Mr. EAVENSON. Absolutely. I think you should be getting at it now and it should be pushed as rapidly as work of that kind can be done.

Senator O'MAHONEY. Are there any other questions?

Dr. FIELDNER. May I ask a question, Mr. Chairman?

Senator O'MAHONEY. Dr. Fieldner.

Dr. FIELDNER. Mr. Eavenson, how do, in general, the labor costs of mining coal in this country and in Germany or in England compare, and also the relative amounts of coal mined per man?

Mr. EAVENSON. Well, I have not seen any German figures for several years, of course, and our costs have increased considerably since I last saw them, but at that time—and I believe it will be true today—the German cost of mining coal was double what it is in this country, and the cost in England now is something like 60 or 70 percent more than it is here.

As far as the production per man is concerned, our national average, I think, is something better than 5 tons. England's, I think, is under 2—perhaps about $1\frac{1}{2}$. And Germany, I think, was something over $2\frac{1}{2}$, although that isn't quite a fair average, because they have so much of that thick brown coal that they mine by machinery; they have very heavy and thick beds.

(In reference to the above statement the following supplemental letter was received from Mr. Eavenson:)

BITUMINOUS COAL RESEARCH, INC.

Washington, D. C.

PITTSBURGH, PA., August 9, 1943.

HON. JOSEPH C. O'MAHONEY,

Chairman, War Minerals Subcommittee,

United States Senate, Washington, D. C.

MY DEAR SENATOR: While at the hearing in Pittsburgh last Friday, August 6, a question was asked me about the relative production per day and the relative earnings of the miners in the Ruhr district and in Great Britain, which I was unable to answer in detail but did in a sketchy way.

I have checked my files and have some information for 1934 in the Ruhr district, and in 1938 for all of Great Britain; I think the last figures are the last ones that have been published, and I have seen no later figures for Germany than those given.

I think the relativity of the production earnings has not varied a great deal, although probably our earnings per man have increased much faster than in the other two countries. It is probable that the United States Bureau of Labor can give you later figures about these earnings.

I will be glad if you will substitute this information for the answers that I gave at the hearing.

Very truly yours,

HOWARD N. EAVENSON, *President.*

COMPARATIVE DATA, UNITED STATES AND FOREIGN BITUMINOUS-COAL INDUSTRIES

In 1934 the Ruhr district in Germany, the producer of the best German coals, had an output per man of 401.7 tons per year, and average earnings per shift of 7.16 reichmarks, or about \$1.79.

In 1934 United States production of bituminous coal was 785 tons per man per year, and average earnings per shift were \$3.62.

In 1938 miners in Great Britain produced 22.9 hundredweight of coal per shift, or 1.29 net tons, at a cost of 16s. 0.34d. per long ton, or about \$3.44 per net ton. Earnings of miners averaged per shift 11s. 2.83d., or about \$2.70.

In 1938 United States production of bituminous coal was 799 tons per man per year, or 4.89 net tons per shift. Average gross realization was \$1.955 per ton. Average earnings per shift were \$4.16.

SENATOR O'MAHONEY. What are the particular factors, if you know, which make the production in the United States per man greater than in either Germany or England?

MR. EAVENSON. Well, the bituminous beds, Senator, referring to our coal, lie generally in flat seams, usually somewhat thicker than the average of the English seam. There is considerably less material to be handled, as a general thing, less roof, and things of that sort. The English use a great deal of long wall work, particularly on account of their deep mines, and the Germans have something of the same sort.

In addition, I think our men are, generally speaking, more efficient, have more initiative—I think they do a little more work. We have had that experience with people coming over here from, for instance, the mines of Scotland, and immediately, after 3 or 4 months, did a great deal more work—got out more coal.

SENATOR O'MAHONEY. The atmosphere was good for production, I take it.

MR. EAVENSON. That might be. It might have had something to do with it. Anyway, they got out more coal.

CONGRESSMAN KELLEY. Somebody asked the thickness of the coal seam in the Ruhr. Do you know?

MR. EAVENSON. You mean high volatile coal. Their seams ran, when I was there, from about 30 inches up to 6 or 7 feet. I would guess the average would be in the neighborhood of 4 or 4½ feet. But they do have some pits of brown coal, near Cologne, 100 meters thick. I saw one place where they were mining, and had two big plants, and that brown coal was probably 30 or 40 feet under the surface, mostly sand and gravel, and there was 350 feet of fuel right below that. They said there was another bed of something like that size. I think there the thickness varies. I think the brown coal in Saxony is also in pretty thick seams.

SENATOR O'MAHONEY. Are there any other questions? (No response.)

I think I speak the mind of the whole committee when I say that this hearing in Pittsburgh today has been particularly valuable. We are very grateful for the contribution which has been made by each of the witnesses from the beginning until the close right now.

It is unfortunate that in the time allotted to us we do not have an opportunity to call upon everybody in the room to make a contribution.

The presence of so many persons here in his auditorium today, from the time of the opening at 10 o'clock until now, at a quarter after 5, I think is, in itself, eloquent testimony to the deep interest that this community has in the work that the committee is endeavoring to carry on.

I may say to those of you who have not been called upon that if, as the result of what you have heard here today, or of your own studies, you care to submit any written statement to the committee, we shall be very glad indeed to include it in the material which will have to be submitted to the full committee before final action is taken.

I want to announce that during the recess this afternoon, the committee had the rare opportunity of inspecting the experimental plant

of the Bureau of Mines here in Pittsburgh. We derived a great deal of pleasure and information from that inspection trip. The Bureau of Mines authorizes me to invite any of you who may be interested to make that inspection after the recess. If you care to go over this plant, the attendants here will be very happy to see that you are properly conducted. You can put your hands into the coal and see the gasoline issue from the tanks where it is prepared, and I think they even might let you pour a little into one of the receptacles which we afterward put on our cars to drive.

The clerk of the committee suggests that I might also announce that if any persons present want copies of the record of today's hearing in advance of publication by the Government Printing Office, they may take that up with the reporter. I am sure he will be very glad to receive any orders that you may care to leave with him.

Now, we interrupted Dr. Storch this morning at the conclusion of his prepared statement. Do any members of the committee wish to address any inquiries to him now?

(No response.)

Senator O'MAHONEY. Doctor, was there anything more you wanted to add?

Dr. STORCH. No; I do not think so, Senator. I will be glad to answer any questions which you may have, if I can.

Senator O'MAHONEY. Any questions?

(No response.)

Senator O'MAHONEY. There appears to be none.

(The prepared statement of H. H. Storch, excerpts of which were previously read, follows in full:)

SYNTHETIC LIQUID-FUEL PROCESSES—THEIR DEVELOPMENT IN GERMANY AND GREAT BRITAIN AND A SUGGESTED PROGRAM FOR THE UNITED STATES

Statement by H. H. Storch, principal physical chemist, Bureau of Mines, United States Department of the Interior before the War Minerals Subcommittee of the Committee on Public Lands and Surveys, United States Senate

PRESENT STATE OF THE ART

One of the many outstanding achievements of modern science is the liquefaction of coal. The chemical transformation of coal into aviation fuel, Diesel oil, lubricating oil, and paraffin wax, has not yet assumed industrial importance in the United States because of the discovery of large petroleum deposits. In Germany, where only small deposits of petroleum have been discovered, there has been since about 1932 a Government-subsidized large-scale development of coal hydrogenation, which was essentially a part of Germany's rearmament program. The discovery of new petroleum deposits in the United States during the past 4 years has not been sufficient to replace that which has been produced and consumed. New deposits have been discovered at about the same rate as in previous years, but the total yield of oil from such discoveries has been too low to replace more than about one-fourth of the oil produced and consumed. Because of the importance of oil for military purposes, it is not safe to assume that our rate of discovery of new oil deposits will increase in the immediate future. Indeed, it is quite apparent that we must develop as soon as possible the production of synthetic liquid fuels from coal and oil shale if we wish to be sure of an adequate oil supply produced within the United States for our armed forces, and for essential industrial purposes.

When heated at about 870° F. with hydrogen gas under a pressure of 3,000-5,000 pounds per square inch, coal undergoes a chemical transformation involving an increase in its hydrogen content and the elimination of the oxygen, nitrogen, sulfur, and ash of the coal. The coal is thus converted into an oil resembling an aromatic petroleum crude oil. The cracking and refining of this synthetic crude

oil is in all respects quite similar to that now used for petroleum oils. The art of producing from coal by this direct hydrogenation process a high octane number aviation fuel containing a relatively large proportion of aromatics so as to provide an excellent rich mixture rating is now known to engineers in Great Britain and the United States.

Another but more indirect process for accomplishing the transformation of coal into oil is also known. It consists in subjecting the coal to the action of steam at elevated temperatures so as to produce a mixture of hydrogen and carbon monoxide gases known as water-gas. This gas, when freed from sulfur-bearing impurities and contacted with finely divided cobalt or iron at 400° F. and 100 pounds per square inch, undergoes a transformation whereby an oil is produced. This oil upon refining yields an excellent Diesel oil of more than 100 cetene number, a relatively poor gasoline of about 50 octane number, and some paraffin wax.

Detailed plant designs can be made available in a relatively short time for both of these processes.

DEVELOPMENT OF THE BERGIUS-I. G. PROCESS IN GERMANY AND GREAT BRITAIN

In 1913 F. Bergius, a German chemist, discovered that coal could be liquefied by the action of hydrogen at a pressure of about 3,000 pounds per square inch and at a temperature of about 480° C. (896° F.). In 1922 his experiments were carried into the pilot-plant stage, using 1 ton of coal a day. The oils obtained by coal hydrogenation using the original Bergius process were of poor quality and high in oxygen, nitrogen, and sulfur compounds, and they consisted chiefly of the less-volatile high-molecular-weight hydrocarbons.

During 1915-25 the I. G. Farbenindustrie A. G., the outstanding German chemical company, succeeded in finding catalysts that were not poisoned by the sulfur in the coal and that greatly increased the velocity of the desirable coal-hydrogenation reactions. They also divided the process into two stages, with different catalysts and optimum conditions for each stage. This company built the first commercial hydrogenation plant at Leuna in 1927. It was designed to produce 100,000 tons per year of gasoline from brown coal, but at first it was operated mostly on low-temperature brown-coal tar and on German crude petroleum.¹ The applicability of the process to the petroleum industry was soon recognized, and commercial plants were built in the United States for gasoline and lubricating-oil production by high-pressure hydrogenation of petroleum.

During 1926-36 the German production of synthetic liquid fuels by hydrogenation of coal and coal tar increased to about 3,500,000 barrels per year. In 1938 the production was 12,500,000 barrels per year and during the next 4 years this production was greatly increased, and the present production is about 28,000,000 barrels of synthetic gasoline per year. This approximates one-third of the gasoline production the Germans are believed to have available for fighting this war.

Meanwhile the original Bergius process had been considered for British conditions, and tests of British coals were made in Germany. The Imperial Chemical Industries, Ltd., modified the process to produce gasoline only in place of gasoline, tar acids, heavy oil, and pitch. This process started with bituminous coal, as it was unlikely that tar, whether from low- or high-temperature carbonization, would ever be available in sufficient quantities to make any large proportion of the country's oil supply.

Experimental work at Billingham started early in 1927, and in 1929 a pilot plant to treat 10 tons of coal a day was built. This plant was operated from 1929 to 1931.

In July 1933 the British Government announced its intention to guarantee the continuance of certain tax-free provisions on light oils made from indigenous materials for a period of years, by means of the British hydrocarbon oils production bill. This enabled Imperial Chemical Industries to undertake the erection of a commercial coal-hydrogenation plant, which was completed in 1935. This plant has a capacity of about 150,000 tons of gasoline per year, and its installation cost was about \$25,000,000. Two-thirds of the raw material used by this plant during 1935 to 1939 was coal, and the remainder, creosote oil and low-temperature tar. Most of the important operating difficulties were successfully solved.² However, there is ample scope for further research and development work.

¹ See Gordon, Kenneth. The Development of Coal Hydrogenation by Imperial Chemical Industries, Ltd.: Jour. Inst. Fuel, vol. 9, 1935, pp. 69-89.

² See reference ¹.

DESCRIPTION OF BERGIUS-I. G. PROCESS

As practiced at Billingham during 1935-39, the coal hydrogenation process consisted in pumping a mixture of about equal parts of powdered coal and a recycle heavy oil with a very small amount of tin oxide and hydrogen, at 3,000 pounds per square inch, through a preheater into two high-pressure vessels in series. The light and middle oils formed in the converter are separated from the heavy oil by distillation and are carried, along with the excess hydrogen and hydrocarbon gases formed in the reaction, into a heat exchange and condenser system. Subsequently the oils are separated from the gases. The gases are scrubbed with oil under pressure to remove the bulk of the hydrocarbons, and the residual hydrogen is recycled to the preheater.

The heavy oil contains in suspension the ash-forming constituents and unreacted coal particles. About two-thirds of this slurry is directly recycled to the paste-preparation system, whereas the remaining third is centrifuged to remove a portion of its solids. The centrifuge oil and the oil recovered by a coking distillation of the centrifuge solids are recycled to the paste-preparation system.

The light and middle oils are separated into three fractions: gasoline, middle oil, and heavy oil. The last is recycled to paste preparation. The gasoline fraction obtained in this first stage (which is otherwise termed the "liquid-phase") constitutes about 27 percent of the total gasoline yield and is of about 72 octane number, which is increased to about 84 by the addition of 3 cc. of tetra-ethyl lead per gallon.

The middle oil from the liquid-phase is pumped with hydrogen at 3,000 pounds per square inch, through a preheater into the "vapor-phase" converters. These converters are of the same dimensions as the liquid-phase converters, but are filled with catalyst pellets. In passage over these catalysts the middle oil reacts with hydrogen to form water, ammonia, gasoline, and lower-boiling hydrocarbons, such as butane, propane, ethane, and methane. The gasoline obtained from this treatment has a high octane rating.

The liquefaction of 100 tons of moisture-and-ash-free bituminous coal produces about 55 tons of gasoline. An additional 100 tons of coal is necessary for generating power and steam.

DEVELOPMENT OF FISCHER-TROPSCH PROCESS IN GERMANY AND GREAT BRITAIN

In 1913 the Badische Anilin und Soda Fabrik in Ludwigshafen, Germany, discovered that hydrocarbons and oxygenated organic compounds could be synthesized from carbon monoxide and hydrogen under pressure at about 350° C. (662° F.), using alkaliized heavy-metal catalysts. These experiments were discontinued because of the First World War. They were renewed in 1922 and led to the development of the methanol synthesis.

In 1925 Fischer and Tropsch, of the fuel research laboratory of the Kaiser Wilhelm Institute in Berlin, Germany, using very active catalysts consisting of metals of the iron group plus various activating agents, found it possible to produce from carbon monoxide and hydrogen, at atmospheric pressure and temperatures of about 200° C. (412° F.), gaseous, liquid, and solid hydrocarbons. In 1925 to 1933, German, British, American, and Japanese chemists developed active cobalt, nickel, and iron catalysts for this synthesis. In 1933 the Ruhrchemie A. G. erected a plant of 1,000 tons of oil per year capacity at Oberhausen, Germany. At the end of 1936 there were five Fischer-Tropsch plants in Germany, with a total capacity of about 115,000 tons (805,000 barrels) of oil per year. During 1937-38 this capacity was doubled by the erection of new plants, and during 1939-42 it was again increased. The present yearly capacity of the German Fischer-Tropsch plants is about 850,000 tons (5,950,000 barrels) of gasoline, Diesel oil, lubricating oil, and paraffin wax. This is estimated at somewhat less than one-tenth of the oil production available to Germany.

In Great Britain the fuel research laboratory at Greenwich has conducted extensive laboratory tests on the activity of cobalt catalysts and on the synthesis of lubricating oils from the lower-boiling oils produced in the Fischer-Tropsch process. British industrial organizations and Government committees have collected information on the engineering development and costs of operation of the process.

DESCRIPTION OF FISCHER-TROPSCH PROCESS

As practiced in Germany in 1939, this process consisted in first converting coal to a mixture of carbon monoxide and hydrogen by reaction with steam. This

mixture of gases, in proper proportion and after suitable purification, was compressed at about 150 pounds per square inch and passed over an active cobalt catalyst at 185°–200°C. (365°–412° F.). The products comprise the following:

	Percent
Gasoline-----	52
Diesel oil-----	26
Wax-----	9
Bottled gas (propane, butane)-----	13

The gasoline boils up to 200° C. (412° F.) and has an octane number of about 50, which may be increased to about 62 upon addition of 1 cc. of tetra-ethyl lead per gallon. Reforming this gasoline by thermal cracking results in about a 67 percent yield of gasoline of 70 octane number, which upon addition of 3.5 cc. of tetra-ethyl lead per gallon increases to 85. This fuel would be markedly inferior to the fuel produced by the Bergius process, particularly because of its very low aromatic content.

The highly paraffinic nature of the Fischer-Tropsch oils, while detrimental to their use as high-grade aviation gasoline, is nevertheless of great value to their use as Diesel oil. The Diesel oil boils in the range 203°–300° C. (412°–572° F.), and has a cetent value of over 100; even when diluted with an equal volume of tar oils or heavy petroleum oils the resulting mixtures is a satisfactory Diesel fuel.

One tone of the above-described products is obtained for every 5 tons of bituminous coal used for all purposes, that is to say, for gas, steam, and power. The cost of production per gallon of oil was estimated in 1940 to be about 18 cents. A much lower cost, namely, about 9 cents per gallon, may be attained if natural gas is available at 5 cents per 1,000 cubic feet or coal at about \$1 per ton for the production of synthetic gas.

COMPLEMENTARY NATURE OF TWO PROCESSES

As may be noted from the description of the Bergius and the Fischer processes, they are complementary rather than competitive. Thus, the former yields high-octane gasoline, with a relatively large proportion of aromatics, but only a mediocre Diesel oil, largely because of the high aromatic content. The Fischer process oils contain only traces of aromatic hydrocarbons and yield an excellent Diesel oil, but a relatively poor gasoline which must be reformed before it is suitable for high-compression engines. The Fischer process oils can be used as raw material for producing high-grade lubricating oil, whereas it is not possible to produce good lubricating oil from the products of the Bergius process.

SUGGESTED DEVELOPMENT PROGRAM FOR THE UNITED STATES—BERGIUS-I. G. PROCESS

Since 1937 the Bureau of Mines has been assaying some of the more important coal beds of the United States as to their amenability for use in the Bergius process. This assay work was done in a small laboratory plant using 100 pounds of coal a day. Information recently obtained from the Imperial Chemical Industries, Ltd., in Billingham, England, shows that while results from a laboratory are a valuable index of the probable behavior of any particular coal, they cannot be safely applied to commercial-size operation.

One important problem in the first stage of hydrogenation of bituminous coal has not yet been satisfactorily solved—the development of a completely satisfactory heavy-oil-from-sludge recovery process. This can be done best on a fairly large scale. To solve this problem, to test improvements developed in the experimental plant, and to obtain assays on a commercial scale it is recommended that a plant capable of producing 200 to 500 tons (1,400 to 3,500 barrels) of gasoline a day be erected. It is recommended that the size of our present experimental plant and laboratory be greatly increased at the same time to speed up obtaining of the data required for the design and operation of the demonstration plants.

FISCHER-TROPSCH PROCESS

In 1928 to 1930 the Bureau of Mines developed an active iron-copper catalyst for the Fischer-Tropsch process. Because of lack of funds, this research was discontinued. In 1942 funds were appropriated by Congress for further experimental work on this process. About 6 months of experimental work on iron and cobalt catalysts has been done, using three shifts a day and six catalyst-

testing units. An engineering laboratory for development of process improvements and for pilot-plant operation on the scale of a few gallons of oil a day is being completed.

In spite of the fact that this testing has been on a very small scale, the results have been most promising, both with respect to the development of better catalysts and in the simplification of the engineering design of the plant. Changes in either factor can reduce the initial cost of the plant and ultimately the cost of the final product. Development of better methods of removal of heat from the synthesis reactions can materially reduce the size of the converters. Improvement in the catalysts can speed up the reactions and may make it possible to produce a good Diesel fuel or a high-octane gasoline at will. With the funds available, the Bureau is pushing its laboratory-scale research as vigorously as possible to develop the Fischer-Tropsch process in these directions.

Further work on this process should expend the laboratory studies and should provide a pilot plant capable of producing about 7,000 barrels of primary product annually, in which the newly developed ideas could be tested on a commercial scale. After completion of a minimum amount of design and operating experimentation, a demonstration plant capable of producing about 300,000 barrels of primary products per year should be erected and operated so as to secure reliable engineering cost data. Sufficient information has been provided to the Bureau engineers to make it possible to build the demonstration plant necessary for this purpose.

Industrial development of the Fischer-Tropsch process in the United States, using cheap natural gas such as is available in the Kansas and Texas fields, is imminent. The cost of production per gallon of gasoline and Diesel oil, with natural gas at 5 cents per 1,000 cubic feet, was given by the Standard Oil Co. of New Jersey in 1942 as about 9 cents. In some areas natural gas may be obtained for less than 3 cents per 1,000 cubic feet, so that the cost per gallon of gasoline and Diesel oil should be about 8 cents. Natural gas at 3 cents per 1,000 cubic feet is equivalent to coal at about 60 cents per ton. Some of the huge deposits of subbituminous coal in our Western States can be mined and delivered even at this low cost. Possible improvements in the catalysts and in the engineering features of the process may reduce the production cost by a few cents per gallon. Hence, in view of the probable increase in cost of gasoline from petroleum (which is now held at 5 to 6 cents per gallon) the Fischer-Tropsch process probably will be developed on a large scale in the near future in cheap natural gas or coal areas.

Summary

The economic welfare of the United States, in time of peace or war, depends to a high degree on an ample supply of liquid fuels. This country cannot afford to risk a threatened shortage, whether it is imminent or more remote, without taking every step to meet the difficulty. By developing the Bergius process for the hydrogenation of coal and the Fischer synthesis liquid, fuels can be supplied from natural gas and our huge reserves of coal and lignite; these latter materials are sufficient to provide liquid as well as solid fuel for combustion purposes for over 1,000 years.

The development of a synthetic liquid fuel industry based on coal as a raw material involves a very large and time-consuming program of plant construction. To fabricate all of the plants necessary to produce the equivalent of our present petroleum consumption of 1.4 billion barrels per year would require about 10 years of work by all of the fabricating companies now in existence in the United States and about 75 million tons of steel. It is, of course, impractical to use the entire fabricating capacity of the United States for synthetic fuel plant construction, and it is therefore apparent that 30 to 40 years may be required for the completion of all the necessary plants. During this construction period we would have available our oil shale reserves for making up any deficiency of oil due to dwindling petroleum supplies. However, the important fact to remember is that because we have only about 50 years' supply of oil available in our oil shale deposits, and because the erection and bringing into satisfactory operation of the necessary oil-from-coal plants will require 30 to 40 years, there is no time to be lost in starting the erection of these plants. This start should be made as soon as possible.

Although the extraction of oil from oil shale has not been considered in this report, it seems logical to view our deposits of shale, which are not now utilized, as another source for substitute liquid fuels. The best methods of obtaining gasoline and oil from shale should be developed along with the Bergius and Fischer processes for making these materials from coal and lignite.

When these three processes have been developed through the engineering stages to the point of commercial application, this country will be well-fortified to meet any threatened liquid-fuel shortages. Plans will be available for the construction of plants to operate on the most suitable raw material in any section of the country. These same plans can be used to build plants in many areas of strategic military importance and to supply liquid fuels to our armed forces, independent of long transportation routes over land or water.

Senator O'MAHONEY. Dr. Fieldner, do you have anything to add?

Dr. FIELDNER. No; I have nothing to add, Senator, except that if there are any other questions we will be very glad to answer them.

I also wish to express, on behalf of the Bureau, our deep gratitude to the people who have given their testimony here today. These men are experts in their lines; they know what they are talking about, and their written statements and oral testimony will, I am sure, be of great value to the Bureau of our further work.

Senator O'MAHONEY. The committee is indebted to the First Assistant Secretary of the Interior, Mr. Michael Straus, who has contributed materially to mapping out the program for the hearings in Washington, here, and in the West. Mr. Straus is in the room now. He has kept himself religiously in the background today.

Do you care to say anything at the moment, Mr. Straus?

Mr. STRAUS. I would like to say, Senator, that the Department has obtained in the last 3 days of hearings a great deal of information that it has sought for a long time and that this hearing in Pittsburgh has been particularly advantageous because it has brought us into direct contact with not only this community but the surrounding communities, as far west as Illinois, and we are very much encouraged by the hearing we have received here.

Senator O'MAHONEY. Thank you.

That concludes, regretfully, our hearing in Pittsburgh.

The committee now stands in recess to assemble next in Salt Lake City.

(Whereupon, at 5:30 p. m., the committee adjourned.)



SYNTHETIC LIQUID FUELS

MONDAY, AUGUST 9, 1943

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE
ON PUBLIC LANDS AND SURVEYS,
Salt Lake City, Utah.

The subcommittee met, pursuant to call, at 10 a. m., August 9, 1943, at the Hotel Utah, Salt Lake City.

Present: Senators Joseph C. O'Mahoney (chairman), Murdock, Gurney, and Thomas (Utah); Congressmen Jennings Randolph, of West Virginia, of the House Committee on Mines and Mining; Robinson (Utah, Granger (Utah), and Rockwell (Colorado); Gov. Herbert B. Maw, of Utah; Gov. John C. Vivian, of Colorado; and W. H. McMains, clerk of the Senate Committee on Public Lands and Surveys.

Senator O'MAHONEY. The committee will please come to order. This is a meeting of the subcommittee of the Senate Committee on Public Lands and Surveys which for the past 2 years has been studying the development of western mineral resources. It has before it for consideration at this time the bill, Senate No. 1243, which authorizes the Secretary of the Interior and the Bureau of Mines to construct and operate demonstration plants for the manufacture of synthetic liquid fuels from coal, oil shale, and other substances.

The purpose of the bill is to enable the Government of the United States to do the pioneer work. It may properly, I think, be called a measure which is designed to bring about the cooperation of the Government with business to create the jobs and the industries which will be needed in the post-war period.

The manufacture of synthetic fuel is in no sense to be regarded as exclusively a war industry. We have fuel enough now existing by way of petroleum and its derivatives to carry on the war, although the evidence before this committee clearly indicates that our petroleum reserves are steadily declining. We will need new sources of liquid fuel. Industry has not as yet been enabled to make the researches which are necessary to make possible the manufacture of synthetic fuels in the United States. That is easily understandable, because industry is under obligation, particularly corporate industry, to make expenditures only so far as they can be justified to the stockholders. So the work has not yet been done.

I am happy to be able to say to this distinguished group assembled here that in our hearings in Pittsburgh on last Friday this bill was endorsed by the representatives of the coal industry, by representatives of the petroleum industry, by representatives of the State government, and, of course, by representatives of the National Government. It was

also endorsed by the spokesman for the United Mine Workers of America. Perhaps it may be appropriate here to call attention to the names of some of the persons who testified at the Pittsburgh hearings. In the first instance, the Governors of those Eastern States—Pennsylvania, Ohio, and West Virginia—were as much interested in the work of this committee as the Governors of Colorado, Utah and Wyoming in our visit to the West. Governor Martin, of Pennsylvania, sent as his representative the secretary of the State Department of Mines, Mr. Maize, who testified in favor of the principles of this bill. Governor Neeley, of West Virginia, was represented by the State geologist of West Virginia, Mr. Tucker. Governor Bricker, of Ohio, was likewise represented. Those interested may obtain copies of this testimony from the committee after it has been printed. The president of the Koppers Coal Co. of Pittsburgh, a company which operates extensively in that area, appeared in person before the committee and also had the director of the Koppers research bureau present. M. Leighton, chief of the Indiana Geological Survey, appeared and testified. Mr. Eugene Ayres, head of the Gulf Research & Development Co., which of course is a branch of the Gulf Oil Co., appeared before the committee and also endorsed the measure. I recite these names in order that it may be made clear that the sponsor of the bill and the Department of the Interior in its testimony are not endeavoring here to set the Government up in competition with private industry, but are merely endeavoring to prevent, in the field of fuel for American development in the future, the same sort of crisis with which we were confronted with respect to rubber. We are looking forward.

The committee had the opportunity this morning of visiting the Bureau of Mines Experiment Station here in Salt Lake City, and we were all very much impressed by what we saw there. Those of you who have not visited that station ought to do it, because you will see that samples of ore from all over the West have been assembled there and are being tested by the Government chemists and metallurgists; and the researchers of the Bureau of Mines every day are discovering ways and means of making available to industry and to the people the practically unlimited resources of this country.

We are very happy, indeed, that Governor Maw, of Utah, and Governor Vivian, of Colorado, are present with us. We are happy to come to this State of Utah, which is represented in the Senate so effectively by Senator Thomas and Senator Murdock. It is only proper to make acknowledgment here of the outstanding work that has been done by both of these gentlemen. I speak of this particularly because I have had personal knowledge of what they have been doing for the development of our western resources. Senator Thomas was the author of the measure for the stock piling of strategic and critical metals, which was passed by Congress at his instance long before the war, long before we were involved even in lend-lease. It was a testimony to his great foresight. Senator Murdock has been actively engaged in all the years I have known him in bringing about the development of minerals here; the fact that we are now making alumina from alunite here in Utah is due to his efforts.

The committee is fortunate to have with it the chairman of the subcommittee of the House of Representatives Committee on Mines and Mining which, for more than a year, has been studying the develop-

ment of synthetic materials. I am referring to Congressman Jennings Randolph, of West Virginia, whose work in the House is known favorably throughout the country.

We are happy to have with us, although they are not members of the committee, other distinguished Members of the House: Congressman Will Robinson; Congressman Granger, of Utah; and Congressman Rockwell, of Colorado. And, of course, the Senate committee itself is represented by the three figures you see at the center of the table—Senator Chan Gurney, of South Dakota, and Senator Murdock, of Utah, and the chairman.

Governor Maw, would you care to make a statement at this time?

Governor MAW. Senator O'Mahoney and Members of the Senate of the United States and House of Representatives, we are very happy to greet you in Utah. We are glad you came to our State to hold this hearing. We greet you and the members of the United States Bureau of Mines who are here, and the other guests.

It is not my purpose to give you any detailed information respecting the possibilities of extracting synthetic fuels and oils from the coals and shales of our State, because others are more prepared—and who are better prepared—to do that and are here to testify. I should like to state, however, that in my humble opinion the coal fields of Colorado, Wyoming, and Utah will be looked upon in the future as the center of the oil industry of the United States. In Utah alone the conservative estimates are that we have in the eastern part of the State from 150 to 200 billions of tons of coal that run from 35 to 70 gallons of oil per ton. In addition, we have billions of tons of oil shales that run a minimum of 35 gallons per ton in oil. In the Uintah Basin we have oil sands, one ridge of which has been studied, and it has been established in that one ridge there is from $1\frac{1}{2}$ to 3 billions of barrels of oil.

With that tremendous supply in this State, added to similar large-scale supplies in Colorado and Wyoming—and the representatives of those States will undoubtedly testify as to their extensiveness—there is little question but what this area will supply a large percentage of the oil needs of this country in the future.

This oil can be extracted from the coal without reducing the heat content of the coal. It takes from the coal the smoke, and makes it a much more desirable fuel; and, after the oil has been extracted and the smokeless fuel is produced, we are right in an area here—Salt Lake City and vicinity—where that smokeless fuel can be consumed, because there are unanswerable demands on the part of the citizens of this area that something be done to take the smoke from the coal and produce a smokeless fuel. So we think you have come to the right place. I want to say to you, as you listen to the testimony—and undoubtedly become convinced—that this area holds great possibilities for the very things that you are exploring, and that you may depend upon the complete support of the State administration in whatever you do. We are anxious to have you come here. We are just a little bit more anxious than the Governor of Colorado that you establish the plant here—aren't we?—until he speaks—and we say to you that if you decide on this area for your plant, you may depend upon 100 percent cooperation, not only on the part of our administration, but on the part of the citizens of this State. I thank you for coming. [Applause.]

Senator O'MAHONEY. Governor Vivian, the committee would be very happy to have you respond, on behalf of the visitors, to the Governor of Utah.

Governor VIVIAN. Thank you, Senator O'Mahoney.

Senator O'MAHONEY. And point out to him that both Wyoming and Colorado are well situated for sites, also.

Governor VIVIAN. I think we can all agree on that. I came here, Senator, to learn rather than to speak with any authority on oil shales or coal and the possibilities of deriving liquid fuels from either or both. I may say, however, that we in Colorado are tremendously interested in the investigations of this committee.

I believe, with Governor Maw, that the States of Wyoming, Utah, and Colorado, because of the large number of tons of coal and oil shales, must of necessity be considered a nucleus around which any plant would be built in the western portion of the United States for the purposes outlined by the committee.

As near as I can find out we have about 900,000 acres of oil shales in Colorado; as a matter of fact, the statistics show we have about 37 percent of all the oil shales in the United States, which is more than any other State. Another author says we have 2,500 square miles of oil shales.

Any of you who have driven through Grand Junction or ridden the Denver & Rio Grande Western Railroad through that town have visualized the immense quantities of oil shales which parallel that railroad and the main thoroughfare from western Colorado to Denver.

One of the reasons we are interested in oil shales at this particular time is because it will cost less to transform it into liquid fuel than it will coal, because of the fact that the overhead is a whole lot less than it is in mining coal. Those huge cliffs of oil shales, so the authorities tell me, can be sent to the retorts through gravity; and, outside of the expense of loosening it and sending it down to the plant, there is very little overhead.

We all know that it is very costly to mine coal, and that the cost of producing liquid fuels from coal, for that reason, would be a whole lot greater than for oil shales.

We have had experiments over a period of years in western Colorado looking to the transformation of those vast deposits of oil shales to liquid fuels. So far as I can learn, there has been nothing definitely concluded.

At a meeting of the western Governors in Salt Lake City several months ago, Governor Maw and I were asked by other Governors to interest ourselves in the possibilities of developing oil shales, particularly because of the fact that Utah and Colorado have more oil shales than any other two States in the West. Upon my return to Denver I asked the Colorado School of Mines, at Golden, if it would not initiate some of the investigations that I hoped would be cooperative with the Federal Government in bringing about some definite knowledge as to the possibilities of commercially transforming oil shales into liquid fuels. President Coolbaugh, of that institution, has been most helpful and cooperative, as has Professor Ball, to the end that we may in a small way do our share toward developing some information, at least, which will be helpful in showing what the State of Colorado can do in a long-range program with reference to oil shales.

Prof. R. D. George, former State geologist of Colorado, who was talking to Senator O'Mahoney and myself some time ago, said we have in Colorado alone an inexhaustible supply of oil shales and, in his judgment, therefore an inexhaustible supply of oil.

It has been estimated, by some of the people interested in that land, that in Colorado alone we have, according to estimates, about 47,000,000,000 barrels of oil which could be extracted from oil shales.

Now, if the plant were to be built in any of the Western States, with all due deference to my good friend, Governor Maw, because of the tremendous amount of oil shales we have in Colorado, I believe it should be built somewhere in Garfield or Mesa Counties, where the greater amount of this oil shale is located and where it could be transformed at less expense than anywhere else.

Of course, those shales in Colorado adjoin, on the west, the Utah shales in the eastern part of that State, and it seems to me it could very well be a cooperative effort to the end that we might, in Colorado, Utah, and Wyoming, do our full share toward bringing about the successful accomplishment of the purpose of this committee.

I might add, in conclusion, Senator—and I think that President Coolbaugh will probably state to this conference—that the Colorado School of Mines will lend every effort possible to assist the committee in arriving at some kind of determination of this issue. And I can assure you that the State of Colorado, in every department, will lend any assistance it can, because I think there is nothing that our people are more interested in in the way of developing the natural resources of our State than to see that oil shale is given every break, to the end that it might at least form a cushion upon which we may rely in the future for our gas and oil. I thank you very much.

Senator O'MAHONEY. Mr. A. S. Brown, who has been acting very generously for the committee in assembling witnesses for this hearing, has just handed me a list which makes it clear to the committee that we are going to have a pretty tough time finding an opportunity for everybody to express himself. The committee has brought with it the First Assistant Secretary of the Interior, Mr. Michael W. Strans, and the head of the Bureau of Mines, Dr. R. R. Sayers, and several of their experts. We felt that it would be helpful if we should bring these representatives of the executive branch of the Government out here to Salt Lake City, where the people would have the opportunity of seeing them and, perhaps, occasionally asking them a question or two. I am going to ask these representatives of the Department and the Bureau, however, to make their statements shorter than perhaps might otherwise be planned. Any prepared statements that they may have can be inserted in the record. I think it will be more helpful in that it will create more opportunity for the witnesses from Utah, Colorado, and Wyoming to be heard, if they will content themselves by merely summarizing what they have to say. It may be possible that on the list that has been handed to me there are not the names of everybody who may desire to be heard. May I ask those from Colorado who are in the room and who wish to be heard, to rise. Thank you very much. Any representative here from Wyoming who desires to be heard? And the Utah witnesses, will they rise? Thank you very much. If any of those who have risen have not already handed their names to Mr. Brown, I hope they will do it at noon time. It is obvious to everybody that to hear all of

these, it will be necessary to place some sort of a limit upon the time that each witness may take. The Chair will, therefore, ask each witness to bear in mind the desirability of completing the hearing today, so that we may conserve the time of all of the witnesses, perhaps within a limitation of 10 minutes for each person, when we consider that members of the committee will doubtless want to ask questions. This may enable us to complete the hearing this afternoon.

Now, I will ask the First Assistant Secretary of the Interior, Mr. Straus, to take the stand and to make the first statement.

MR. STRAUS. Mr. Chairman, members of the committee, Senators, Governors, and all who are gathered here. I appreciate this opportunity to be the first witness in the western hearings on this bill sponsored by Senator O'Mahoney.

The Department of the Interior is known in this area as a western department because of the activities of the Bureau of Reclamation, the Geological Survey, the metallurgical work of the Bureau of Mines, the Grazing Service that has national headquarters here, and others of its regular activities.

At the present time, however, it has two other national responsibilities. It happens to be the Solid Fuel or Coal Administration for War, and the Petroleum Administration for War. It is in connection with the Petroleum Administration for War, that we are considering the seriousness of the situation which can be met by the bill. It was in connection with the work of the Petroleum Administration for War that the acuteness of the situation first was revealed, and the necessity that consideration be given to the manufacturer of synthetic liquid fuels.

The Petroleum Administration for War has recently completed the first thorough comparison of petroleum consumption in this country as contrasted with discoveries of the year 1942. In the year 1942 the discovery of additional domestic petroleum reserves in this country was only 42 percent of our depletions. That showed us that we were looking toward the bottom of the barrel.

Wildcatting and exploration is being encouraged in every way possible. There are a great many wildcat expeditions out working and prospecting for oil, and they have been for the past 2 years. They are finding some oil, but they are finding it at a lesser rate than they have in previous years—more men looking and less oil found. That increases the seriousness of the situation.

There are many experts that have testified in the previous 4 days' hearings of this committee that there is a limit to how far we can go in our natural petroleum reserves. It is generally accepted that 14 or 15 years will bring the end in sight, at our present rate of consumption, which is the greatest rate of consumption this country has ever seen. And we do not consider that only a wartime proposition; it was increasing before the war, and we think it will stay up after the war with the full arrival of the airplane age.

The Bureau of Mines, fortunately, has been looking forward to meeting this situation and found three very excellent sources for liquid fuels other than natural petroleum. All of them have been studied, and the Bureau of Mines has made gasoline from all these sources. One is natural gas, which works all right. However, there is a very limited reserve of natural gas. As I recall the figures pre-

sented by the Geological Survey and the Standard Oil Co., that supply, if used for gasoline, would only be good for a few years. Then, there is shale, of which I hope we hear a great deal today. The best figures on that show that there is better than half a century's supply of oil that may be obtained from the domestic shale reserves—65 years, I think, is what the experts advise us.

The Bureau of Mines has obtained oil and gasoline from shale. I think, Governor Vivian, in your State a few years ago, there was a retort plant running that produced 3,000 barrels. Three thousand barrels sounds like a lot of oil in these days of A coupons, but it isn't a drop in the bucket when it comes to our present demands.

Then, turning to coal, we really get into a large supply. The Geological Survey tells us that there are 3 trillion tons of coal in our domestic reserve in this country—not millions, not billions, but trillions, if you can remember how many ciphers that is. They estimate that at the present rate of consumption of coal, and using coal only for the purposes for which it is now being used, that would last us 3,000 years. But, they also can make gasoline and synthetic liquid fuels from this coal. Members of this committee saw that done by the Bureau of Mines plant in Pittsburgh. It shows it can be done. We know it can be done. The Senators used that in an automobile which they drove on the streets of Pittsburgh, and they are convinced motorcars will run all right on that.

But, even with those reserves for synthetic fuel, and the fact that we are in the laboratory stage and know how to do it, will not pull us out of this particular condition of being at the bottom of the barrel of natural oil supplies. It takes a long time to install a new industry. All we have at the moment is the scientific ability to do it. We also have had Bureau of Mines men go abroad; one of them is in this room who recently flew to England—they are making plenty of it, and keeping hundreds of bombers over Germany. Hitler is fueling this war with synthetic gasoline, or liquid fuels, chiefly derived from coal. More than half of these liquid fuel supplies is from coal, according to our best information. But it took them 20 years to get there—and we are starting late. We are not starting in time, but we still can make many moves. We know how to make this stuff, but we have not solved the problems of mass production, or the engineering problems, the economic problems, the transportation problems, the know-how of making synthetic fuel in quantity from either shale or coal. And that is what we seek to do, and that is what Senator O'Mahoney's bill gives us an opportunity to commence. The Department of the Interior does not view this bill as opening either competition between synthetic fuels and natural fuels, nor between government and industry. Natural fuels, natural gasoline, are cheaper now, and will remain cheaper for some time to come, although synthetic may be made for as low as 12 cents per gallon. You can make gasoline from natural petroleum much less than that.

But we are moving forward to the time when the choice is not between synthetic and natural gasoline. The choice is, synthetic liquid fuel or no liquid fuel. There is no competition in this. The philosophy of the Department of the Interior on this bill is that we do not produce large amounts or build a flock of plants, but build a minimum-size plant of each character needed for these various sources,

and work out the engineering details, so that when the time comes—which we feel will certainly come very soon—these problems will be solved, and private industry can take up after all this work is done, and multiply the number of plants a hundredfold or a thousandfold as the needs of our economy require.

Senators, I do not wish to give any technical testimony, as there are men much better fitted than I am to give such testimony. I do want to report that the Department of the Interior is anxious and willing to get at this work as soon as it is authorized by legislation; and I want, at this time, to give the unqualified endorsement of the Department of the Interior to the bill that you are now considering. Thank you.

Senator O'MAHONEY. Dr. Sayers, will you be good enough to take the stand.

STATEMENT OF R. R. SAYERS, DIRECTOR OF THE BUREAU OF MINES

Dr. SAYERS. Mr. Chairman, Senators, members of the committee, Governors of the States, ladies, and gentlemen, it gives me a great deal of pleasure to be in Utah and talk to you for a few minutes on this particular subject. I am not going to talk very long because, as the chairman has told you, there are a great many witnesses from the State here to be heard, and they should be heard. The statement that I have has already been prepared, mimeographed, and is available for distribution, or will be printed and available later on. All I intend to do at this particular time, with your permission, Mr. Chairman, is to emphasize a few of the points that were brought out by the Secretary and by the Governors. One of the points was illustrated yesterday when we made our trip to the various plants in this particular district, and that was that we do have a great deal of ingenuity and inventive genius and the willingness to apply new ideas to industry. That was shown in the plant that we visited at Geneva, and also in what is now an older plant but still it shows ingenuity and inventive genius—out at Bingham Canyon, probably the most outstanding mining of copper in the world at the present time, producing a large proportion of the copper in this country. No less so is the petroleum industry and the coal industry, particularly the petroleum industry in supplying gasoline and other substances we get from petroleum and that we can get from coals and oil shales and oil sands.

There is no question at all but what these can be obtained, and obtained in quantity. There are methods that have been developed both abroad and in this country, and improved in this country materially, and can be improved further, and it is those improvements we need to make and in the application of the methods that have been developed.

However, we cannot expect industry at this time to take up the great expense that will be necessary when the time of a return on the investment is rather remote from the investor's viewpoint. We can, however, and believe we should, as has been stated by the Secretary, supply the know-how for the industry of this country to produce liquid fuels in quantity. It can be done. He has called your attention to Germany; he has called your attention to England as to what they have done and are doing. We are not doing that at this time. We have most of that knowledge. Much of it is already in the United

States. On a small scale we are producing about 7 gallons per hundred pounds of coal in 24 hours in our small plant at Pittsburgh, sometimes called the Bergius method. Much work needs to be done. I am not going into this in detail. I shouldn't go into it in detail, for there are many more people yet to be heard.

There have been statements of the amount of shale available from which we can make these gasolines and liquid fuels, and the amount of coal that is available from which to make it. You have much of the resources in this part of the country. That needs further emphasis—and I think Mr. Straus has emphasized to you—that it isn't one plant we are talking about and one method and undertaking to put all emphasis upon that, but we are going to emphasize we want at least three, and maybe four, and possibly can have that many different methods from which you will want to produce these liquid fuels. It seems those details can be brought out as we go along in the talks today. And I believe that we ought to call attention to the fact that we are interested for the country in obtaining the know-how of producing those not only from a technical but also from an economical viewpoint. We need to know it all, and you can't work out costs in a laboratory so they will be anything like accurate. We believe we can reduce those costs and have a much better system in a reasonable period of time. I think that is all I have to say, Senator, unless there is some question.

Governor VIVIAN. Do you know of your own knowledge of what the situation is with reference to that plant at De Beque? Is it fully equipped so it might function now?

Dr. SAYERS. I think not. And there are new methods that have been developed in the last 10 years. I think that was started in 1929 and it has been dismantled. The equipment is no longer available. It will produce, as you well know—and the Secretary told you it produced 3,000 barrels of crude oil, from which we could make various types of liquid fuels.

Senator MURDOCK. Dr. Sayers, there is some apprehension—and I think it has been given some little publicity here in Salt Lake City—that this bill, if and when it is enacted—and I am very hopeful that will be at a very early date—might bring the Government into competition with private industry. Now, I am sure that you, as Director of the Bureau of Mines, have no such idea, have you?

Dr. SAYERS. I can assure you I have not, and I don't think any of us in the Department or the Bureau have any such idea.

Senator MURDOCK. And your own intention and sole purpose is to aid private industry in establishing what will be a new industry in this country?

Dr. SAYERS. For the benefit of the people.

Senator MURDOCK. One more question. I think you mentioned, as raw materials, shale, coal, and natural gas. Now, we are finding oil sands out in the Uintah Basin in Utah, which are becoming more and more important as they are investigated. I think the Bureau knows about those sands and has them in mind in connection with its program.

Dr. SAYERS. We do, Senator.

Senator O'MAHONEY. Any other questions, Senator Thomas, Congressman Robinson, Congressman Randolph—

Congressman RANDOLPH. I would like to take this moment to say that once again the House subcommittee is delighted to participate with the Senate in these hearings, and particularly should I like to note the presence of three Members of the House from the States of Utah and Colorado. I point out that my colleagues, Congressmen Robinson and Granger, have followed closely the work which the subcommittee of the House has done on this matter, and that Congressman Rockwell, of Colorado, has been made a member of the House Mines and Mining Committee and I am sure that he will be interested also in what is being done. I should like to add also that our hearings in Washington for 2 days and the hearing in Pittsburgh for 1 day were informative; and yet I note today the presence of women, and on those two earlier occasions we had no ladies present. I would like the record to show the interest of the women of the West in this subject here today.

Senator O'MAHONEY. I am sure it is unnecessary for me to say to the Members of the House and to the Governors that they are at perfect liberty to ask any questions that may occur to them as the witnesses proceed.

Congressman ROCKWELL. Dr. Sayers, may I ask this question: In your research work, you would make no distinction as between coal or oil shale or gas—they would be considered on an equal footing?

Dr. SAYERS. Yes. However, it has been mentioned that costs would be a factor, and what we are trying to determine for industry and the people is the one that is most feasible and suitable for the production of liquid fuels, and I believe we will need to test all three sources.

Congressman RANDOLPH. Congressman Granger is a member of the House Agriculture Committee, and I think it is well to note here in Salt Lake City that one of the witnesses from a great oil company at the Pittsburgh hearing brought out interesting evidence of the petroleum industry in the replaceable products to make synthetic fuels, notably agricultural products.

STATEMENT OF WARWICK M. DOWNING, ATTORNEY AT LAW, OF DENVER, COLO.

Senator O'MAHONEY. Mr. Downing, are you ready to proceed, sir?

Mr. DOWNING. Yes, sir; any time. Mr. Chairman, I have prepared a statement for the record, but I will hand it, with your permission, to the reporter. I will refer only very briefly to some of the points I think I should make now. One is, that we are at the beginning of a gasoline shortage. I don't think it is correct to refer to this shortage as something that is going to take place 10 or 15 years in the future. Some people seem to think that because we have 15 years' supply that we can get along for 15 years without any new petroleum discoveries. That is a mistake. We are already short of gasoline. That is why we are being rationed. If we weren't short, we wouldn't be rationed. We are going to be rationed much more severely in the future than we have been in the past. And we must realize, in this war effort, the daily productive capacity of our 20,000,000,000 barrels of oil reserve is not sufficient to carry on the war and the civilian economy unless we have new discoveries or our dwindling supplies are augmented by synthetic liquid fuels.

Out here, Mr. Chairman, we are not particularly concerned as to whether you go in the direction of coal or shale. I have the figures here to show that in our three States of Colorado, Wyoming, and Utah, we have 75,000,000,000 barrels of recoverable shale oil, and also a trillion barrels in coal. That is far short of the Nation's supply. But we have within a few miles of this city at least half of all our country's bituminous and anthracite coal, and we have a greater percent of the shale. It is up to the scientists to find out which is best. No matter whether it is oil shale or coal, I think we have here the greatest treasure store of any place in the world. There is no place in the world where within a radius of a few hundred miles, as here, you have products so valuable as the coals and the shales of Colorado, Wyoming, and Utah.

Now, I am going to amplify and show the reason why it is daily productive capacity and not oil in reserve that counts. You can take oil out of the ground just so fast. In respect to flush production and newly discovered production and wells that flow, if you try to take oil too fast, you will produce wastefully. You are liable to lose or destroy in reserve anywhere from two to five barrels for every barrel of oil improperly or wastefully produced. That is why we must not try to overproduce. As to wells of settled production, the oil will flow through rock just so fast, and it is impossible to make them produce any faster. Therefore, we cannot produce this 20,000,000,000 barrels of oil in reserve as fast as we would like to; on the contrary, it will take 40 to 50 years to produce it all.

We have always depended, and must always depend, on new oil pools to furnish enough flush production, which, with settled production, will supply current demand. Without this new flush production, we cannot hope to supply our demand. We must also remember that our existing wells decline something like 1 percent a month. In other words, if we are now producing 4,000,000 barrels a day, a year from now those same wells, under the maximum rate of production with good practice, would produce only 3,600,000 barrels. And that is the progress that is going on, and that is one of the reasons why the 20,000,000,000-barrel reserve cannot be drawn upon like with a spigot. Secretary Ickes began telling us 2 years ago of the danger of a shortage. What he said is now coming true. We are consuming oil much faster than we are making new discoveries; wells must be drilled deeper; they cost more; wages are much higher; skilled labor for new work is almost unobtainable; materials cost more; wells produce less and fields are getting smaller; our Federal Government is not helping, but is hurting, all efforts to find new oil reserves; we are not making new discoveries sufficient to counteract the imminent shortage.

Now, this plight that we are in, as I look at it, is not in any respect new. Secretary Ickes long ago called attention to it. Senator Johnson of Colorado made this statement 2 years ago, about the time we entered the war:

I am told by military experts that if the present war continues 5 years—and it is likely to do so—that there will be an extreme shortage of motor fuel in this country, and that it will be necessary to extract the motor fuel from coal, as Hitler is now compelled to do. We cannot afford to lose any battles and lives due to any preventable shortage.

Secretary Ickes, a year and a half ago, called vigorous attention to the necessity of taking measures to prevent an oil shortage. Yet, with

all that warning, after a year and a half of war, here we are in Salt Lake City, and, so far as I know, the only thing that our Government has done to help relieve the situation and give us ample gasoline is in the last Interior Department appropriation bill, wherein the Interior Department was given \$254,000 to help find new oil. \$254,000! And for that, we must thank Senator O'Mahoney. Now, that is a pitiful exhibition of the record of the National Government in meeting this bad situation. We also had a small appropriation for the coal hydro-generation plant at Pittsburgh; I think it was \$85,000.

Yet it is a matter of life or death to keep up our normal supply of gasoline necessary to win the war.

I do wish, however, certainly to commend most heartily the Bureau of Mines, the United States Geological Survey, and the other governmental agencies. They have been composed of men who worked hard and have vision, and are to be congratulated and thanked for the work they have accomplished, and for the efforts they have made.

Secretary Ickes has accomplished some splendid things toward the development of new oil; but, on the other hand, he still refuses to reduce the royalty on the public domain to the universal one-eighth; he refuses to give the industry the encouragement that is due it, to go onto the public domain, in equality with other lands of the Nation and find new oil.

I believe the greatest possibility of finding new oil in this Nation is on the public domain, right out here in Colorado, Wyoming, and Utah. Let me emphasize that Mr. Ickes, who otherwise has done so much, fails and refuses to give us the one-eighth royalty, and to give us a fair lease form which is so necessary to put pep and ginger into the campaign to find new oil reserves on the most favorable locality, namely, on the public domain. Senator O'Mahoney should not only be thanked for the additional appropriation he obtained for the United States Geological Survey, but it is highly pleasing that he is the Senator who introduced and is fathering the bill under consideration. Our hope for the future is that Congress will pass this bill, and that the Interior Department will act on it promptly. If we can't have the oil we need, we know we can have liquid fuel from both oil shale and coal. In order to be safe, we must proceed speedily, energetically, and intelligently, to make available our liquid fuel reserves.

Senator O'MAHONEY. May I interrupt you? I think it may be proper to have the record show that the President signed a bill which provides for a guaranteed royalty of 12½ percent for 10 years in the discovery of new deposits. That, of course, does not go as far as our recommendations have been in the past, but at least it was a step in the direction of encouraging searches for new deposits of petroleum in the way of royalties.

Mr. DOWNING. I think, Senator, you are to be congratulated and thanked for that piece of legislation. If the Department had given liberal interpretation of that bill, its purpose would have been accomplished; but, where they give a restricted, narrow interpretation, they have reduced its benefits. If the Government isn't going to help the people find new oil, I am glad we are here in a meeting trying to get new sources of supply, so we can make up the shortage of oil which the Government has neglected to encourage. And I think whatever the Government does do on oil, it is going to be another version of the old story, "Too little, too late." Let's get busy on the coals and shales,

and let them talk as long as they please about the various ways to go about helping out the oil situation. This question of coals and shales is highly technical, and I am not prepared to discuss scientific questions, but there was an article that appeared in the Oil and Gas Journal of April 22, by B. H. Weil, of the research department of the Gulf Oil Co., concerning oil shales, which is illuminating.

The Bureau of Mines has been busy on coal, but there hasn't been a hand turned over in 20 years to help develop the oil shales, or in any research work concerning oil shales. In the meantime, we have always looked upon oil shales as great deposits of some sort of a mysterious substance. The processes have not been worked out; the costs have not been worked out. But, as we look into it, we find that recent discoveries in mining and refining, if applied to shale, will solve the worries of 20 years ago, and almost as cheaply.

Senator O'MAHONEY. Can you advise the committee anything about the ownership of the shale deposits of Colorado?

Mr. DOWNING. Just in a very rough way. There are about 900,000 acres of shale lands; roughly speaking, something like 100,000 acres have been patented. I never had the exact figures on that, but I put it at that.

Senator O'MAHONEY. What is the area which is reserved?

Mr. DOWNING. Oh, something like 45,000.

Senator O'MAHONEY. Acres?

Mr. DOWNING. Yes. That leaves something like 750,000 acres which is public domain. How much of that is covered by placer locations, I don't know. My guess would be 100,000 acres. I don't think it is all covered, or anything like all covered. I would say, something like 100,000 acres.

Senator O'MAHONEY. How much of this—do you have any idea how much of this is owned, controlled, or leased by the big oil companies?

Mr. DOWNING. The patented part of it is owned almost entirely by the big oil companies. The unpatented part of it is owned by the little fellows, the boys who go out and find things and generally do not have the money with which to finish. I do know the Carter Oil Co. has patented a lot of land. The Texas Co. has large holdings. The Union Oil Co. of California has a large piece. These pieces of ground run from five to eight thousand acres. The patented land is owned very largely by the major oil companies. And the poor boys have to be content with the unpatented placer locations.

Senator O'MAHONEY. Are there any more questions?

(No answer.)

STATEMENT SUBMITTED BY WARWICK M. DOWNING, ATTORNEY AT LAW, OF DENVER, COLO.

Mr. DOWNING. My name is Warwick M. Downing. I reside in Denver, Colo. I am a lawyer interested in the oil business, chairman of the Colorado Conservancy Authority, and represent Colorado on the National Conference of Petroleum Regulatory Authorities and on the Interstate Oil Compact Commission.

We are at the beginning of a gasoline famine. We are told publicly for the first time that it is necessary to ration gasoline, not only to

save rubber, but to save gasoline. Unless the unexpected happens, civilian consumption of gasoline must be greatly curtailed in the near future. A shortage may develop that will slow down our war production at home, and may impede our fighting front abroad. We have good reason to believe that the German military effort is being bogged down for want of gasoline. Can we afford to take the slightest chance of a similar catastrophe?

There can be no excuse for the serious petroleum shortage, now imminent. We have had prominently before our eyes the mistake of rubber. We are here in Salt Lake in the midst of plenty. Let me give you the following official figures: as to shale from United States Geological Survey Bulletin 729 by Winchester, and as to coal from the report of the Energy Resources Committee to the National Resources Committee, 1939:

	Recoverable shale oil	Coal, anthracite and bituminous
	<i>Barrels</i>	<i>Tons</i>
Utah.....	25,680,000,000	93,128,612,000
Wyoming.....	1,826,400,000	620,309,931,000
Colorado.....	47,625,598,000	316,758,433,000
Total.....	75,131,998,000	1,030,196,976,000

This shale oil reserve is therefore about three times the consumption from the beginning to this date; it is sufficient to supply our total consumption for 50 years; if used to supplement our dwindling petroleum supply, our country need not fear any shortage of gasoline for a couple of generations or more, even if not another barrel of petroleum should be discovered, and even if demand should be greatly increased.

This coal, at the present rate of consumption, would furnish liquid fuel for approximately 750 years. Total recoverable shale oil in the United States is estimated at 92,144,985 barrels, and total coal—anthracite and bituminous—is given at 2,241,307,787,000 tons. Lignite is given as 939,457,443,000 tons.

There is nothing secret or mysterious about petroleum supply. We have had a lot of loose talk about our enormous petroleum reserves, but no intelligent person has been deluded. Everybody who knows anything about the oil business knows the following: Current demand is and must be met largely by flush production. This means that every year we must discover sufficient new oil pools to give us the necessary flush production. Our reserves cannot be drawn on at will as by opening a spigot. That part of our production which is flush production must be controlled; it must be produced slowly and in an orderly fashion. We must remember that underground pressure at the bottom of an oil well may run from 1,500 to 2,000 pounds to the square inch, and that down the flank of the structure below the oil is generally a great accumulation of water. By production control, we may use that water under such heavy pressure to scour and cleanse the sands of oil, making possible a 90-percent recovery of all the oil in the sands, but without control, this water under such tremendous pressure may blow up through the oil sands to the bottom of the hole, with the result that the water cones a channel to the bottom of the well, so that the oil is isolated or sidetracked, as it were, and thereby production is cut to perhaps 20 percent or less. As regards settled production, this oil can

travel through the interstices of the rocks just so fast; you cannot draw it off as fast as you want, but only as fast as nature permits. Any attempt to force production beyond the rate fixed by good conservation practice causes waste, and very soon a rapid decrease in production. For every barrel of oil produced in excess of good practice, we may lose from 2 to 5 barrels underground. Therefore, what counts is not the amount of oil in reserve, but daily productive capacity; how much oil can we produce today, tomorrow, and in the future, so long as the war lasts?

We know that the productivity of all our wells is subject to a gradual daily decline, approximately at the average of 1 percent per month. We know that at the end of a year from now the productive capacity of our present wells will have declined something like 400,000 barrels daily. We know that our war demands are mounting. We know that we are producing pretty nearly all we can without waste. We know that new discoveries are becoming less and less, and that new fields are becoming smaller and smaller. We know that our Government is not taking the steps it should to encourage new production.

Our present plight is not to be considered in any sense as unexpected or unforeseen. Anyone who gave the subject a moment's thought knew the present result was inevitable. On February 7, 1940, in my statement to the Cole committee, I gave the figures to show that, to maintain our present position, we should be obliged to discover more than a million barrels of new oil each year. On October 16, 1941, in a paper before the Interstate Oil Compact Commission, I stated—I think it was the first time ever publicly stated—that for the first time in our history new discoveries were being found at a much less rate than present consumption. I said that if the necessities of war should require quickly an increased production, it might or might not be available. On the same day the Interstate Oil Compact Commission demanded an aggressive development program.

The Independent Petroleum Association of America on October 21, 1941, warned that there is a great danger that our reserves may prove inadequate to meet the steadily increasing demands due to the defense program.

Secretary Ickes on October 18, 1941, and I think many times before and since, has warned of the oil shortage.

On March 17, 1942, Senator Ed Johnson of Colorado, a member of the Senate Military Affairs Committee, said:

I am told by military experts that if the present war continues 5 years—and it is likely to do so—that there will be an extreme shortage of motor fuel in this country, and that it will be necessary to extract the motor fuel from coal as Hitler is now compelled to do. We cannot afford to lose any battles and a lot of lives through any preventable shortage of natural resources.

The National Conference of Petroleum Regulatory Authorities, set up by Secretary Ickes and composed of representatives of the regulatory commissions of the various oil-producing States, the men who know more about oil supply than anybody else, passed the following resolution on April 15, 1942:

We must not repeat the mistake of rubber. Is it not better to be alert, to plan ahead, to realize that we may have unforeseen events and disasters before final victory? Therefore, among other things, we should begin to get ready

to make available for petroleum needs our proven deposits of coal and oil shale, which have all the oil we can possibly need during the war and for a thousand years in the future. We should not wait until the necessity is upon us, until it is too late. We should at least be in the blueprint stage. The Secretary of the Interior should be given the money to enable his scientific men to perfect the necessary processes, already fairly well worked out, and to build test plants.

Let me quote the following ringing, impressive statement from Secretary Ickes to the national conference on April 14, 1942, as follows:

No one knows better than you that, if we did not have oil—adequate, ever-continuing supplies of it—we should have no choice but to surrender to Hitler on whatever terms he might dictate * * * that is why it is the solemn responsibility of each of us to see that this oil is available—adequate, ever-continuing supplies of it—this year, next year, and for as many years as this war may continue.

All the foregoing leads up to this question. What has our Government, which has had ample warning of the impending oil shortage, done to prevent or minimize the same? Our Government is asking the utmost sacrifices of all of its people, but what is the Government doing to prevent possible disaster to the war effort?

So far as encouraging the discovery of oil, the only concrete thing done by our Government, at least so far as I know, is that Congress recently increased the appropriation for the Conservation Branch of the United States Geological Survey by some \$254,000, in order to give it funds to help conserve existing oil fields on the public domain, and to help find new ones. For this we owe our thanks to Senator O'Mahoney. We also owe him thanks for the O'Mahoney bill, intended to reduce the royalty on the public domain as an aid in the discovery of new oil reserves, but which has largely failed of its purpose through stringent regulations promulgated by the Interior Department. Possibly I should mention a niggardly appropriation for experimental work at Pittsburgh by the Bureau of Mines, commenced some years ago. The only legislation pending, the only other thing even in prospect, is the O'Mahoney bill in the Senate, S. 1243, prepared, I believe, with the assistance of the Bureau of Mines. Possibly I should mention proposed legislation to create the Petroleum Reserves Corporation, which is to be empowered to spend our public money anywhere outside the United States for any purpose connected with the oil business. This may be fine for Venezuela, Colombia, and other foreign nations, but why not some money spent to encourage development of American oil?

I do wish, however, to commend the Bureau of Mines and the United States Geological Survey as agencies of Government which have looked ahead, planned ahead, and worked ahead; but unfortunately these agencies are not permitted to campaign in favor of their recommendations before the Congress or the people. I should also mention the aggressive leadership of Governors Maw, Vivian, and Hunt, as well as our Senators and Congressmen from the States of Utah, Wyoming, and Colorado.

Except for the foregoing, we have had nothing but talk. Secretary Ickes has written some very splendid articles and reports on the necessity of doing things. He has recommended an increase in the price of crude as necessary to make new discoveries possible; but he continues to refuse to encourage development on the public domain.

He continues to insist on a royalty on the public domain which is discriminatory, excessive, unfair, and forbidding to enterprise.

Otherwise I know of nothing being done to avert the catastrophe of a shortage of oil supply. Others in our Government are doing everything possible to defeat what Secretary Ickes is trying to do. Our great governmental agencies are busy fighting over methods and personalities, but doing absolutely nothing; they display an incredible incapacity, delay, and indecision. Everybody seems to fear that an increase in price, or anything to help the independent wildcatter find new oil reserves, is a gift of something to Standard Oil, and therefore must be avoided. How can you expect private enterprise to find more petroleum when the price is held at 60 percent below parity, although costs are far above parity and skilled labor is almost unobtainable.

Reviewing the record of the past, I think we may safely assume that our Government will give no substantial encouragement to the discovery of more oil. If anything is done, it will fall within the definition of "too little, too late." If encouragement should be given, no one knows how much oil is left or how much might be discovered in the near future.

I think, therefore, it is high time we should begin to think of liquid fuels from coal and oil shale. That is our only alternative, and it is a necessary alternative. The supply will last a thousand years or more. In comparison with oil, there will be no dry holes; skilled manpower needed will be less; the steel required will likewise be less; plant cost will be less; and we have reason to believe the cost of the product to the public will be comparable to a fair price for petroleum.

On the other side of the picture we must remember that it will take time: time for research work, time for blueprints and plans, time to assemble materials, time for construction, indeed more time than was required to put synthetic rubber into production.

We ask this committee to speak plainly, to tell our Government we are in mortal peril. Our Government, as a matter of precaution, if not a matter of necessity, should tackle in a big way the matter of procuring adequate supplies of petroleum products or substitutes from coal and oil shale. It is not necessary, as it was in the case of rubber, to build plant capacity sufficient for the entire national needs; I think beyond any question it will be sufficient if we build plant capacity for liquid fuel at a rate equal to the normal decline of existing oil wells that is, at a yearly rate of 400,000 barrels daily.

Let me summarize the latest available technical information contained in a learned article appearing in the *Oil and Gas Journal* of April 22 and 29, 1943, by B. H. Weil and Whitney Weinrich, of the Gulf Research and Development Co., Pittsburgh, Pa., entitled "Oil Shale and Shale Oil." This article gives a picture of a 500-foot shale oil cliff strata, averaging 16 gallons per ton, or 1,555,509 barrels per acre. The cost of open-quarry mining operations is 40 cents per ton of material laid down at the place of retort. If block-caving systems be used, this will add from 20 to 30 cents a barrel to cost. Obviously, the more favorable quarry operations would be used first. The cost of retorting, including amortization and all overhead, is 60 cents per barrel. Shale oil can be produced at a cost of from 75 cents to \$1.50 a barrel; even at the present state of technology, and considering the present increased costs of operation, shale oil can compete profitably with petroleum stabilized at a cost of about \$1.50 a barrel. The cost of

plant is only about \$375 per barrel of shale oil produced daily. In other words, the cost of plant necessary to produce 400,000 barrels daily of shale oil would be about 150 million dollars. This is \$100,000,000 less than the sum of money Petroleum Administrator Ickes requested the industry to spend in 1943 in discovery work. At the rate of discovery so far, it appears reasonably certain that new discoveries this year will not exceed 150,000 barrels daily. Though refining is more complicated than the refining of petroleum, there are no serious obstacles. It is noteworthy that if our Government had provided us with an additional 400,000 barrels daily, this would have given 27,000,000 motorists 4 gallons of gasoline a week and 2,000,000 homes their fuel requirements for this winter.

I attach extracts from this article. I also attach extracts from a statement made by me to the National Conference of Petroleum Regulatory Authorities on April 12, 1943. This statement was made prior to the Weil-Weinrich article. In this statement, it is shown that on the basis of daily production, it takes twice as much steel to drill and equip oil wells as to build oil-shale plants. It is also shown that the manpower required is very much less.

We hope this committee will continue its leadership, and induce the Congress to take quick, decisive action. For our Government, in the midst of plenty of oil shale and coal, to permit any failure in our war effort, or any impediment in our civilian economy, would show us incompetent as a people to govern ourselves.

EXTRACTS FROM OIL SHALE AND SHALE OIL, BY B. H. WEIL AND WHITNEY WEINRICH, PRESENTED BY WARWICK M. DOWNING

Quotations from an article, Oil Shale and Shale Oil, by B. H. Weil and Whitney Weinrich, of the Gulf Research & Development Co., which appeared in the Oil and Gas Journal on April 22, 1943. Mr. Weil was invited to appear to make the statement direct to this committee, but was unable so to do. He is perhaps the greatest authority on shale oil we have. Extracts from his article are as follows:

The conclusion reached in that period (the period of a premature boom in the early 1920's) was that shale-oil products might not be able to compete with petroleum products for many years—not until dwindling supplies of petroleum had forced prices to a much higher level. The discovery of new methods of refining such as catalytic cracking, reforming, polymerization, and hydrogenation, however, has weakened in many minds the "facts" behind this prediction, and to these men it does not appear unlikely that the too-heavy drain on our petroleum production facilities and reserves may cause the beginnings of a shale-oil industry to occur shortly.

Oil shales occupy an intermediate position between coal and petroleum, resembling both fuels in certain respects. There is considerable controversy as to the attendant costs of mining oil shale. A recent survey by "a reputable mining engineer" indicates a cost slightly under \$0.40 per ton of material mined for open-quarry operations, laid down crushed at the point of delivery, including operating overhead. "Block-caving systems, also used by low-grade copper producers, will add from \$0.20 to \$0.30 per barrel of producible oil to the above figure, depending upon the details of the particular operation. Obviously the more favorable quarry operations will be used first."

In regard to the production of other petroleum products, it is possible by varying the refining process to obtain high yields of other products such as Diesel oils, lube oils, etc., although the production of a full range of products is by no means as easy as from petroleum.

The process of hydrogenation, while as yet too costly to compete with American petroleum refining methods as regards petroleum oils or coal, has special merits in the case of shale oils.

The economies of shale oil and shale-oil products are not defined clearly, since many of the more detailed estimates were made before the advent of modern petroleum cracking and reforming methods and are also outdated in estimates of technique and costs of mining.

The costs of mining these shales and delivering the crushed shale to appropriately located retorts are not so clear. The estimates previously given of \$0.40 per barrel of producible oil delivered, crushed for open-pit operations and \$0.60 to \$0.70 per barrel for block-caving operations are among the latest ones available. Other recent estimates agree fairly well with these, although estimates in the 1920's ranged as high as \$3 or more per barrel of producible oil.

Again, the costs of retorting (carbonization) are not so clear. The Bureau of Mines estimated that for its N-T-U experimental retort (operated in 1920's) the costs of retort operation, labor, and amortization would be \$0.40 per barrel of shale oil, and that maintenance, insurance, taxes, superintendence, and general overhead would be an additional \$0.20 per barrel. Since their mining costs were \$0.64 per ton (the oil shales used by them gave nearly 1 barrel of oil per ton), they listed the cost per barrel of oil at approximately \$1.25.

A recent estimate, including labor costs at early 1942 levels and charging plant equipment at recent but not war-boom levels, places the total cost of mining and retorting at \$0.90 per barrel. "To this must be added about 20 cents per barrel for general overhead, including taxes, and from this amount must be deducted a credit of an average of 30 cents or more per barrel for the recovery of the shale counterpart of natural gasoline and also the usable B. t. u.'s contained in excess noncondensable fixed gases from the shale."

These estimates are based on shales containing on the average one-half barrel or less of oil per ton mined. Richer shales, which are abundantly obtainable in Colorado, would cost less per barrel. Thus it would seem, on the basis of these and other estimates, that shale oil can be produced for approximately \$0.75 to \$1.50 per barrel.

Costs of production by use of hydrogenation are not at hand, but it is stated that it will prove less expensive to obtain gasoline by hydrogenation of shale or shale oil than by hydrogenation of coal (costs for the latter are estimated currently at \$0.12 to \$0.30 per gallon). Thus, considering all methods, it might be safe to conclude that a considerable amount of shale gasoline may be produced at prices not greatly in excess of present petroleum gasoline levels.

The subject of byproducts is rather complex. Shale oil refining might provide a rich supply of cresols, phenol, pyridines, and ammonia, but how much of the cost of refining could be assigned to these substances is not determinable. On the conservative basis of a phenols content of 1 percent of crude shale oil, an industry refining 250,000 barrels of shale oil daily would produce 275,000,000 pounds of phenols annually, more than the entire present synthetic and coal-tar production. There appears little question that such amounts of phenols could be absorbed by even the recent peacetime market at perhaps a slightly lower price than was then current; as a future source of phenols, therefore, shale oil may prove important. Waste shale disposal, as previously mentioned, will present a serious problem to a large-scale industry.

As to the cost of plant construction, here again estimates differ. No large commercial plant has ever been erected in the United States, but, based on pilot-plant studies by various operators, estimates of the costs of construction range from less than \$400 to over \$1,000 per ton of shale treated daily; that is, a plant capable of processing 1,000 tons of shale daily would be estimated to cost from \$400,000 to over \$1,000,000. These estimated costs would cover complete plants, with all auxiliaries.

On the basis of oil per day, in 1924, M. J. Gavin estimated the cost of a retorting plant at about \$2,190 per barrel of oil per day. The same report contained an estimate of \$3,000 per barrel per day for a retorting plant, including mining-apparatus investment. In 1926, C. P. Bowie and M. J. Gavin, on the basis of a pilot plant, estimated that a commercial plant would cost only \$375 per barrel of oil produced daily. A United States Geological Survey report in 1934, using admittedly high figures, estimated a cost of about \$1,500 per barrel of daily oil production for a plant "to mine and retort 10,000 tons of oil shale per day (at a cost of \$700 per daily ton of capacity)." The corresponding net investment in the United States petroleum industry was \$1,800 per barrel of crude oil produced and refined in 1937, including all investments in pipe lines, marine transportation, marketing, etc.

Based on all these figures, it would appear questionable if the often repeated statement that "oil from shale must wait upon much higher prices" reflects the

true facts. It does appear that very large-scale utilization of oil shale resources will take many years to develop, however, with a capital investment comparable to the total now invested in the oil industry.

Even if increased exploration reverses the present declining rate of petroleum reserves, increased costs seem certain to occur, and it has often been stated that shale oil, at its present state of technology, can compete profitably with petroleum stabilized at a cost of about \$1.50 per barrel.

STATEMENT OF WARWICK M. DOWNING AT MEETING OF NATIONAL CONFERENCE OF PETROLEUM REGULATORY AUTHORITIES IN SESSION IN THE CONFERENCE ROOM OF THE HONORABLE SECRETARY OF THE INTERIOR ON APRIL 21, 1943

That the Bureau of Mines, under the jurisdiction of Mr. Ickes, be immediately given the authority and the money to do whatever is necessary and proper, preparatory to building plants to utilize our oil shale and coal for the extraction of synthetic petroleum.

On April 15, 1942, a little over a year ago today, we passed a resolution which it will be well to quote in full:

"We must not repeat the mistake of rubber. Is it not better to be alert, to plan ahead, to realize that we may have unforeseen events and disasters before final victory? Therefore, among other things, we should begin to get ready to make available for petroleum needs our proven deposits of coal and oil shale, which have all the oil we can possibly need during the war and for a thousand years in the future. We should not wait until the necessity is upon us, until it is too late. We should at least be in the blueprint stage. The Secretary of the Interior should be given the money to enable his scientific men to perfect the necessary processes, already fairly well worked out, and to build test plants."

What has been done about this extremely important matter?

Concerning oil shales, absolutely nothing; not a penny has been spent in research work for about 15 years. The budget for this fiscal year ending June 30, 1944, above referred to, does not ask for a dime for any such work. Concerning coal, for the fiscal year 1942-43, \$85,000 was provided for land, structure, and equipment for an experimental plant for synthesis of motor fuel at Pittsburgh, Pa., and \$8,000 was provided for expenses. The plant has not yet been completed. The budget before mentioned, as I read it, proposes to appropriate \$85,000 for the next fiscal year.

Dr. Arno C. Fieldner, Chief of the Fuel Service of the Bureau of Mines, in his statement before the O'Mahoney committee on October 12, 1942, concerning the availability and cost of coal hydrogenation for the production of gasoline and liquid fuels, says:

"The small laboratory plant at the Central Experiment Station in Pittsburgh, Pa., should be enlarged to pilot-plant scale so that the necessary data for designing commercial plants may be obtained. Also, there should be intensive research on the chemistry of the processes with a view to producing a product of higher octane value and also at lower cost.

"The Nation should protect itself from disaster in this field of synthetic rubber. Such protection involves the erection and operation of full-scale, industrial-size units so as to solve the engineering problems involved in these processes. * * * The cost of such a pilot plant is estimated at \$2,000,000."

Very little is known in this country concerning processes to utilize coal or shale as a source for petroleum products. However, it is believed that Germany obtains at least half of her gasoline and motive fuel from coal. Without such utilization of coal, Germany could probably not have carried on the war, and Russia would have been greatly hampered.

Though in the midst of plenty, we are faced with the probability, or the possibility, of a shortage of oil, the most important material, the most strategic of all materials, absolutely necessary to win the war. We know that our petroleum supplies are dwindling. After the experience concerning rubber, is it possible that our national administration, with its eyes open, and after having been forewarned, will make the same mistake concerning oil? Long before we begin to run short of petroleum, we should have completed and thoroughly understood the mechanics of extracting oil from our shales and from coal. When in the midst of a long war, where the issue may depend entirely upon the nation having the greatest petroleum supply, it is suicidal, and indeed treasonable, for public officials to fail to complete detailed plans, so that when and if the need therefore arises,

plants may be started immediately for the extraction of liquid fuel from our coal and oil shales.

This statement will not be complete until I give you briefly the facts and figures which show the immensity and value of our shale and coal deposits, a treasure beyond compare, the greatest of all our national resources.

We have in the United States in our oil shales, 92,144,985,000 barrels of recoverable shale oil. At or close to the common corner of Colorado, Utah, and Wyoming, shale beds contain 75,131,988,600 barrels of shale oil. These figures were taken from the statement of A. J. Kraemer, of the Bureau of Mines, to the O'Mahoney committee, on October 12, 1942, concerning the "Availability and Cost of Production of Shale Oil in the United States."

Our national coal reserves aggregate 3,180,765,230,000 tons, of which 939,457,443,000 tons are lignite coals, leaving 2,241,307,787,000 tons of higher-grade coal more suitable for extraction of hydrocarbons.

Of the coals other than lignite, Wyoming, Colorado, Montana, and Utah have a total of 1,095,656,254,000 tons, or practically one-half of the total reserves of like coal in the United States. These figures were obtained from the report of the Federal National Resources Committee of January 1939, of which Mr. Ickes was then chairman.

At the present rate of consumption of petroleum products, our Utah, Wyoming, and Colorado shales would supply our needs for 50 years at the present rate, even if a barrel of petroleum be not produced. A ton of coal on the average will produce more than a barrel of oil. Our coal reserves are sufficient to supply our coal and petroleum requirements for a thousand years.

Dr. Fieldner, in his statement before the O'Mahoney committee, says the estimated cost of producing gasoline from coal varies from 12 to 25 cents per gallon. Kraemer, in his statement before the O'Mahoney committee, estimates that crude shale oil may be produced at \$2 per barrel. This doesn't include refining.

However, it must be strongly emphasized that very little is known in this country concerning the best methods of obtaining oil from coal or shale. The above costs are based on figures of the past. Concerning shale, open-pit mining, recently developed in our country, may be found practicable, and greatly reduce the cost; after intensive research, it may be found possible to extract the oil from the shale rock and refine it in one operation and with one heating, thereby reducing cost very materially.

If American ingenuity and American technical ability is put to work on the job, we may be assured that a substitute product will be made available at less, perhaps much less, than the above figures. Scientific men tell me that such cost would be greatly reduced if proper allowance be made for byproducts, which, by the way, are of the greatest importance. However, it is not a matter of a few pennies' difference in cost; it is a matter of national safety.

A comparison between the method of obtaining oil by wells from oil sands, and of obtaining oil from oil shales, will be illuminating. Each method takes time. After the first well, it may be 2 or 3 years before the field is drilled up and in production. It should not take any longer to build large plants to treat the oil shales. Both methods are expensive. The cost of the average oil well is more than \$50,000. Such wells on the average will not produce 50 barrels a day for 20 years, their average life; but if so, the cost of wells or plant would be \$1,000 per barrel per day for a limited time. An oil shale plant, producing 10,000 barrels a day, might cost \$10,000 though probably less. This is at the same figure, \$1,000 per barrel per day. The average oil well requires 161 tons of steel. This is on the basis of approximately 3 tons for each barrel of daily production. Kraemer says that a 10,000-ton shale oil plant would require only 15,000,000 pounds of steel, or at the rate of 1.3 tons of steel for each barrel of oil per day. No estimate is given for steel required in mining, but this would be small. The oil shale method, however, has this difference: A plant once constructed will last for the life of the shale deposit, and there will be no dry holes.

Unquestionably, it is entirely practicable to obtain liquid fuels or synthetic petroleum from oil shales and coal. The cost thereof, according to present knowledge, should not greatly exceed the cost of petroleum if petroleum was priced at parity. The amount of steel required is less. As between coal and shale, it is principally a question of what research will show. But an immense amount of work and intensive research is required to determine the best and most economical methods concerning both coal and oil shale. This work should be immediately started.

In respect to every other industry, the brains of our people have found ways to do the job better and cheaper. If this rule follows with respect to coal and shale, we have the right to expect as good or better products that will sell as cheaply or more cheaply than present petroleum products. The great advantage of obtaining these products from coal and shale is that the risk of drilling (which, by the way, is becoming a very great risk, with few plums) will be entirely eliminated.

I am told that the necessary appropriation for shale is \$800,000, and for coal from \$2,000,000 to \$5,000,000.

I am not urging that we start now to produce oil from shale or coal. It will never be possible to supplant crude oil or its products by extracting liquid fuels from either coal or shale. But nothing is more certain than that the day will come when our petroleum supply will be insufficient. God grant that day may not come during this war. But whenever it comes, especially if it should come during the war, we should be ready.

WARWICK M. DOWNING.

Mr. DOWNING. I have been asked to state the relative advantages as between using coal or oil shale as a source for liquid fuel. My information, briefly, is as follows:

There is really no basis of comparison as the products are entirely different. From coal, through hydrogenation, is manufactured a synthetic substance which may be used as a substitute for gasoline, and perhaps other petroleum products. This, however, is a complicated and expensive process.

From oil shale there is obtained by a fairly simple retort process what I understand to be a low-grade petroleum or the equivalent thereof. This product may be refined or may be used without refining for fuel oil. Shale oil is, in a sense, petroleum in nature's process of making.

The cost of a plant for shale is much cheaper. The cost of mining is much less. The cost of retorting the shale is much less than the cost of the complicated synthetic process relating to coal. On the other hand, a ton of coal will yield a larger quantity of the product. A serious problem concerning shale is the disposal of the dump rock.

As to the time element, a shale plant, being much less complicated, can be built much more quickly. The quantity of steel required is very much less—1.3 tons for the oil shale plant per barrel of product per day, as against 6.5 tons to 14.1 tons for the coal plant per barrel of product per day. Shale rock has only the one use, whereas coal has other uses. The question of byproducts can be determined only by further research. The principal question is one of locality in relation to markets. Obviously, it would be better to build a plant in Pennsylvania for the eastern market and in Colorado or Wyoming for the Rocky Mountain market. Shale fits in better with a declining petroleum supply. Our petroleum supply will be sufficient for gasoline and lubricating purposes for many years if oil shales supply, wholly or in large part, the liquid fuel demand and coal is used in its natural state wherever possible. The Bureau of Mines believes that the work concerning both coal and oil shale should be vigorously carried on simultaneously.

Congressman ROCKWELL. I would like to ask a question here. I have had a number of requests on the question as to whether this unpatented land, under the bill in the Senate, would require the paying of assessments. Could you answer that? The bill by Senator McCarran provides they must be registered. A number of the men in the oil-shale country were afraid they would be compelled to do assessment work, the same as mining claims.

Senator O'MAHONEY. The law suspending operation of assessment work applies, of course, to oil shale deposits as well as to any other mineral deposits, and my recollection is that the suspension was merely for the current calendar year. Isn't that right, Senator Murdock?

Senator MURDOCK. For the duration of the war.

Senator O'MAHONEY. That suspension, then, I would take it, cannot be brought to an end except by new legislation.

Senator MURDOCK. The question of the gentleman concerning Senator Hatch's bill now pending is answerable here by Joe Leach of the Grazing Service, with headquarters in this city. He has a copy of the bill and he can inform the gentleman as to its provisions.

Senator O'MAHONEY. Mr. Leach, do you care to answer that question?

Mr. LEACH. Mr. Chairman, Senate bill 1139 refers to placer-mining claims, deposits of phosphate sodium, oil, oil shales, and gas, and was to cover the thousands of oil shale claims in western Colorado, eastern Utah, and southwest Wyoming that were located long before the passage of the leasing act, and on which no assessment work or any patent work had been done; and it was to require that within 180 days after the passage of this act, S. 1139, that they would be made of record in the local United States Land Office. One of the reasons in connection with this was the grazing districts. This land showed up as public vacant land and we were using the surface for grazing purposes, and lots of these locations were let out to other stock operators, and caused quite a bit of confusion. So we were much in hopes something would be done as proposed in Senate bill 1139.

Senator O'MAHONEY. Mr. Leach, the question of the gentleman, I believe, is whether the bill requires the resumption of assessment work immediately following registration.

Mr. LEACH. Section 2 of that proposed bill provides that during any following year assessment work must be done. I don't know whether that means immediately after the 180 days, or just what it means.

Senator O'MAHONEY. I will say to the gentleman that the measure was referred to a subcommittee in the Senate Committee on Public Lands and no report had been filed at the time Congress took the recess. I know no hearings have been held, so there is ample time for a full examination of the terms of the measure before the committee will act upon it. And I assume that perhaps a similar bill is pending in the House.

Congressman ROCKWELL. The reason I asked about the point Judge Downing brought up, many of our small operators he speaks of are the only ones left, and they are afraid the bill will put them out of business and the only oil shale left would be in the hands of the big companies. That was the reason I brought up that question, to have you gentlemen answer it, because I couldn't answer it.

Mr. DOWNING. I would like to say a word. It is designed to hit the little fellow, and I hope Congress doesn't pass the bill.

Senator O'MAHONEY. It is not a subject before the committee at the present time, and there will be lots of opportunity in the future.

Congressman RANDOLPH. I would like to make a very brief observation following Mr. Downing's testimony.

Senator O'MAHONEY. Certainly.

Congressman RANDOLPH. Mr. Downing and Secretary Straus have both told the committee of the tremendous depletion of our fuel oil during the prosecution of this war, and Mr. Downing particularly has spoken of the necessity for doing something now. I would simply like to reinforce what these two witnesses have said, applying to just one phase of the war. In a raid of allied planes from bases in Great Britain over the occupied countries and Germany itself, we are using 4,000,000 gallons of crude oil; of course, that being transferred into high octane gasoline of a million gallons. Those raids are averaging between 5 and 10 a month, therefore we are actually using 20,000,000 to 40,000,000 of gallons of crude oil each month in just that one phase of the theater of war. What the witnesses say is correct.

Mr. DOWNING. I think that is true, and I think that use will increase. It is up to our Government to see that the oil is available. Mr. Ickes has in fact said it was his duty to see that the oil is available, and I certainly hope it is.

Senator O'MAHONEY. I take it, Mr. Downing, your testimony is to be interpreted as endorsing the bill before the committee?

Mr. DOWNING. I thought I made it clear that I endorse this bill most heartily. I have referred to how little was being done in Washington. Yet, when you look at what the chairman of this committee is doing on this bill, and the small appropriation for the United States Geological Survey, the O'Mahoney bill, I think, is quite a contribution and I am for the bill 100 percent. Not only am I for it, but we have great leaders in our western country, the Governors of Colorado, Utah, and Wyoming, and they will support you 100 percent.

Senator O'MAHONEY. I wanted the record to make it emphatic you are for this bill.

Mr. DOWNING. I am, indeed.

Senator O'MAHONEY. Thank you, very much. Mr. Kraemer, will you please take the stand? The next witness is the Senior Refinery Engineer on petroleum and natural gas for the Bureau of Mines at Washington.

STATEMENT OF A. J. KRAEMER, SENIOR REFINERY ENGINEER, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Mr. KRAEMER. The declining trend of discoveries of new crude-oil reserves and the rapid rate of depletion of existing reserves have directed attention to the importance of developing new sources of liquid fuels and other products of petroleum refining before the need for the substitute arises. If it can be assumed that a chronic shortage of petroleum will exist in the United States in a few years, the conclusion seems inevitable that something should be done to prepare for the eventuality.

For that purpose, the enormous deposits of oil shale in various sections of the United States should receive serious consideration. The adequacy of the supply is beyond question, and no other use has been found for it. Furthermore, on the basis of present information, it seems evident that comparable products can be made from oil shale at lower costs than from other sources, with the possible exception of natural gas when it is available at low cost.

The late Dean E. Winchester, formerly of the Federal Geological Survey, estimated that the shales in Colorado, Utah, and Wyoming could yield 75,000,000,000 barrels of oil and the shale in Kentucky and Indiana nearly 17,000,000,000 barrels. In contrast to these figures the total quantity of petroleum produced in the United States from 1859 to 1941 was 25,000,000,000 barrels, of which nearly 30 percent was produced from 1936 to 1941, inclusive. Thus it is evident that the supply of raw material is ample.

Retorting (that is heating or distilling in a special apparatus) is the only practical means that has been developed for extracting oil from shale. Retorts differ in design and in operation and their function is to separate the oil formed when oil shale is heated to a sufficiently high temperature from the gas and water vapor on the one hand, and the mineral matter or ash on the other. In the United States, oil shale ranges in assay value (potential oil yield) from less than 15 to more than 60 gallons to the ton of shale. Deposits of sufficient size and richness to warrant utilization range in assay value from about 25 to 45 gallons of oil to the ton. In round figures, the products of oil-shale retorting are 10 to 20 percent of oil, 25 to 30 percent of water vapor and gas, and 50 to 65 percent of spent shale.

Many countries have never produced enough petroleum to meet their needs, and in some of them methods have been developed for making liquid fuels and other products from oil shale and coal. Like other natural materials, oil shales throughout the world differ in the characteristics that influence the methods of successfully making oil from them. Consequently methods and apparatus that may be satisfactory when used on oil shales of another country may not be applicable to oil shales of the United States.

Realizing this condition, the Bureau of Mines began to study oil-shale utilization in 1916, and for more than 25 years has had a practical interest in the subject. In fact, the Bureau operated an experimental oil-shale mine, retorting plant, and shale-oil refinery in Colorado on a pilot-plant scale between 1926 and 1929. In experiments with two retorts of commercial size and differing in design and operation, the Bureau of Mines developed retorting techniques applicable to oil shales of the United States. A total of approximately 6,000 tons of oil shale was mined and retorted under pilot-plant conditions, and 3,600 barrels (150,000 gallons) of shale oil was produced. It can be stated definitely that high yields of oil can be obtained from these shales in large-scale operations. However, the Bureau's field and plant studies of oil shale and shale oil were terminated more than 13 years ago, and little is known regarding the application of any improvements in oil-shale retorting methods. Similarly with reference to refining shale oil, application of modern methods in all probability will give results much improved over those obtained 13 years ago.

To plan a program to cope with the situation one or another of three premises must be assumed:

First. The shortage of petroleum products is acute, and it is urgently necessary to produce a substantial quantity of substitute material as soon as possible.

Second. The shortage of petroleum products is not acute now and will not become acute for several years.

Third. There is yet time for further exploratory and experimental studies of the elements of oil-shale utilization.

If the shortage of petroleum products is so acute as to require substitutes from other sources in the shortest possible time, oil-shale retorting evidently offers the most practical solution of the problem. Giving due recognition to the magnitude of the engineering problems involved, methods developed by the Bureau of Mines for oil shales of the United States can be put into large-scale operation. No other use has been found for oil shale, and the supply is adequate.

If the shortage of petroleum products is not as acute as is assumed in the previous paragraph, and if it is decided that the technology of oil-shale utilization should be developed now as a stand-by source of liquid fuels in the future, erection and operation of a mine and retorting plant on a semicommercial scale (500 to 2,500 tons of shale a day) may be the desirable action to take at this time. Equipment of commercial size could be used and information obtained regarding methods and costs of mining, crushing, and transporting oil shale, and the details of large-scale retorting could be improved. Unit costs of mining, retorting, and other operations would be larger in proportion to the quantity of oil produced. Nevertheless, costs of commercial-scale operation could be estimated closely, and unless it is urgently necessary to produce a substantial quantity of oil from shale as soon as possible regardless of expense, it is believed that a relatively small-scale operation would be preferable for exploring further the possibilities of oil-shale utilization.

However, on the basis of information available to the Bureau of Mines, and in view of all of the considerations, I believe that now—while there is yet time—further exploratory and experimental studies should be made of oil-shale mining, transportation, crushing, and retorting and of shale-oil refining and testing. I believe that such a program on a scale of 75 to 200 tons of shale a day would be preferable under present circumstances to a plan based on operations on a scale between 500 and 10,000 tons a day. Oil-shale retorts have been developed recently by United States concerns, and one or more of these may merit consideration for experimental trial over a period of time long enough to determine their practicability. In this way, improvements in retort design and operation could be made in the shortest time with a maximum of efficiency and a minimum of expense.

Under such a program, quantities of shale oil large enough for pilot-plant studies would be available, and recent advances in petroleum-refining methods could be employed to improve the technique of converting shale oil into other products. It seems likely that such studies would result in marked improvements in yields and characteristics of products by comparison with the work done 13 years ago.

When this has been done, plans can be made for utilizing oil shales of the United States on a large scale on the basis of knowledge derived from engineering information that is directly applicable to oil shales of the United States, rather than by inferences from experiences in other countries with different oil shales and different economic conditions.

A more detailed discussion of the factors of oil-shale utilization has been prepared, in which the Bureau's studies are described, inferences are drawn as to what can be done with oil shale and shale

oil, and costs are estimated. The report is offered for publication in the record of these hearings. (Report follows Mr. Kraemer's testimony.)

Senator O'MAHONEY. May I ask you how oil made from shale compares with petroleum?

Mr. KRAEMER. So far as we know, the oil made from shales of the United States is no better, if as good, than the purest petroleum is. It is about equal, not to make any disparaging comparison, to your Wyoming oil.

Senator O'MAHONEY. What is the first product of the process to which oil shale has been subjected?

Mr. KRAEMER. It is crude shale oil. It is, in general terms, a rather bland, highly odorous oil.

Senator O'MAHONEY. Am I correct in assuming it is not petroleum?

Mr. KRAEMER. Well, strictly, petroleum, I would say, is material that comes out of the ground in liquid form. It is a heterogeneous mixture of certain organic compounds, and shale oil is another heterogeneous mixture of other compounds. Some of the compounds are common to both.

Senator O'MAHONEY. What type of gasoline can be made from shale oil?

Mr. KRAEMER. We have to rely on what we knew about shale oil and petroleum refining in 1929, and by the methods of that time we can make, by what is known as thermal cracking, a satisfactory automobile gasoline, and the yield will be low. From 42 gallons of shale oil, we will get about 23 gallons of gasoline.

Senator O'MAHONEY. What would be the octane value of this gasoline?

Mr. KRAEMER. It will be comparable to commercial automobile gasoline that would be put on the market in competition with the low octane rating, which is about 72 now and has been 74, possibly by the use of a little lead.

Senator O'MAHONEY. You will recall, in Washington, at our first hearing, they had before the committee an engine, an ordinary gasoline motor, which was operated by two tanks of fuel?

Mr. KRAEMER. Yes.

Senator O'MAHONEY. One of which was ordinary gasoline and the other of which was the gasoline made by the hydrogenation process from the coal at the Pittsburgh plant. By turning a switch, the source of the fuel could be interchanged from the synthetic to the natural, and from the natural to the synthetic.

Mr. KRAEMER. That's right.

Senator O'MAHONEY. When that switch took place, no change in the operation of the engine was noted. In other words, the two fuels were interchangeable. Would that be true also in respect to gasoline made from oil shale?

Mr. KRAEMER. Yes; certainly.

Senator O'MAHONEY. So, if this work is done, and we learn how more efficiently to refine oil shale, we can depend upon securing a product that is equal to the ordinary motor fuel?

Mr. KRAEMER. Yes. I think that is undoubtedly true. And I want to emphasize, that by the use of the methods of petroleum refining that has been developed since 1929, it seems entirely likely that instead of

23 gallons of gasoline from 42 gallons of shale oil we will get a substantially higher yield.

Senator O'MAHONEY. Do you want to say anything about the experience of other countries in the production of shale oil?

Mr. KRAEMER. Oil shale has been retorted for a long time throughout the world. The industry goes back a hundred years. It started in Scotland and France about the same time. Oil shale retorting is being done at present in Scotland, France, Australia, South Africa, and in Japan. And the thing about those operations that impresses me is, apparently they are dealing with a different type of material than with which we have to deal. Therefore, their operations are not of much help to us, and, except in a general way, we are apt to find that we will have to develop processes for our own shales.

Senator O'MAHONEY. About how much oil has been produced, throughout the world, from shale? Would you approximate that?

Mr. KRAEMER. I haven't looked that up, Senator. It would be a large figure. There was a time when the Scottish operations probably were larger than they are now. Operations have fluctuated in Australia. We know little or nothing about what the Japs are doing. The Estonian operations, which I neglected to mention a moment ago, are of considerable magnitude. But I would certainly be safe in saying it is much less than the amount of petroleum that has been produced in this country, very much less. Other than that, I wouldn't want to try to make an estimate on it. I have never seen such a figure, and don't know whether that information is available.

Senator O'MAHONEY. Are there any other questions?

Senator MURDOCK. I would like to ask this: Were the experiments carried on by the Bureau of Mines from 1926 to 1929 in western Colorado large enough to be considered commercial?

Mr. KRAEMER. If it is necessary to do so, we could now put in plants based on that experience, and make oil. We are definitely sure about that.

Senator MURDOCK. The report you refer to in the last paragraph of this article refers to a more detailed report than has already been included.

Mr. KRAEMER. Yes; it has been prepared for the record.

Governor VIVIAN. Are there any large commercial quantities of oil being produced from oil shale?

Mr. KRAEMER. The English are producing oil from oil shale, and probably some of it is going into aviation. I don't know what the Japanese are doing.

Congressman ROCKWELL. If you carry on this work, would the Bureau of Mines wish to cooperate with the School of Mines, so we could get the benefit of their advice?

Mr. KRAEMER. Yes. One of the objects of making the oil is to get others to build refining processes.

Congressman ROCKWELL. And get whatever assistance you can from the School of Mines?

Mr. KRAEMER. Yes.

Congressman RANDOLPH. You speak about developing and improving the process of retorting of oil shales. Is that the reason you advocate to this committee a 200-tons-per-day plant rather than a 10,000-tons-a-day plant?

Mr. KRAEMER. Yes. I think that on that small scale, with the flexibility that a single unit gives us, and the ease with which it can be modified, and the simplicity of operating conditions, by using more than one retort, exemplifying different methods of operation, we can get information that may lead to more economical operations than those that were developed in our previous work.

Congressman RANDOLPH. Can the inference be drawn by the committee that it is not necessary for large sums of money to be expended to get results that could be produced on a commercial scale?

Mr. KRAEMER. The information that could be derived, on the scale I advocate, would be engineering, which would be used for designing plants and operating them.

Senator O'MAHONEY. Governor Maw, do you wish to ask a question? Governor MAW. No.

Senator O'MAHONEY. Governor Vivian?

Governor VIVIAN. Is it being successfully produced on a commercial basis in the United States?

Mr. KRAEMER. Not that I know of.

Senator O'MAHONEY. Senator Gurney?

Senator GURNEY. No questions.

Senator O'MAHONEY. We appreciate your statements. Thank you very much.

(The report referred to by Mr. Kraemer is as follows:)

OIL SHALE AS A SOURCE OF LIQUID FUELS

INTRODUCTION

Recent startling shortages of vital materials, such as rubber and certain metals, have directed attention to the importance of developing new sources of necessary commodities before the need for the substitutes arises. Oil shale is a case in point as a source of liquid fuels and raw materials for plastics and other new industries in the light of the declining trend of discoveries of new crude-oil reserves and the rapid rate of depletion of existing reserves.

The Bureau of Mines has been concerned with oil-shale utilization in a practical way for more than 25 years and operated an experimental oil-shale mine, retorting plant, and shale-oil refinery in Colorado on a pilot-plant scale between 1926 and 1929. During the 10 years after the Bureau's experimental operations terminated in 1929, interest in oil shale as a source of liquid fuels was at a low ebb in the United States, although foreign countries that had little or no indigenous petroleum continued to exploit their oil-shale resources. In recent years, interest has revived in the United States, and serious thought is being given to the possibilities of oil shale for augmenting dwindling petroleum supplies. As an example, the National Conference of Petroleum Regulatory Authorities meeting in Washington, D. C., April 21, 1943, passed the following resolutions:

RESOLUTION OF NATIONAL CONFERENCE OF PETROLEUM REGULATORY AUTHORITIES

"Whereas it is apparent that the fullest and most effective utilization possible must be made of all scientific and technical knowledge, whether public or private, in planning to meet the motor fuel and other needs for hydrocarbon products of the future; and

"Whereas there was created many years ago the technical services of the United States Bureau of Mines, who by experience and character of personnel are in position to provide excellent aid to the private companies and individuals engaged in the petroleum, natural gas, and coal industries: Therefore, be it

"Resolved, That the Congress be urged to appropriate and the Honorable Secretary of the Interior be urged to direct the expenditure of funds adequate to enable the Bureau of Mines to proceed intensively with its research and experimental work in petroleum, including the determination of proper methods to obtain oil from our vast reserves of coal and oil shales, and to build pilot plants for both coal and oil shale for that purpose."

It is significant that the National Conference of Petroleum Regulatory Authorities is an organization of representatives of the Governors of the petroleum-producing States. The purpose of the organization is to advise and assist the Petroleum Administration for War.

Statements that have come to the attention of the Bureau of Mines recently regarding oil-shale utilization and the part the Bureau has played in oil-shale research in the United States indicate general misinformation and lack of understanding of the circumstances. Consequently, it has seemed desirable to review the past and to relate the history of oil-shale research and development to present circumstances and future possibilities.

The term "oil-shale" is applied rather loosely to various natural bituminous rocks. Gavin¹ has defined oil shale as "a compact, laminated rock of sedimentary origin, yielding over 33 percent of ash and containing organic matter that yields oil when distilled but not appreciably when extracted with the ordinary solvents for petroleum." This definition, slightly modified, has been adopted by the American Society for Testing Materials.² The criterion of more than 33 percent of ash apparently was adopted by Gavin from Ashley,³ who suggested that a material yielding less than 33 percent ash be considered a coal. By Gavin's definition, materials such as the diatomaceous shales of the Monterey formation in California are not true oil shales, as a large part of the organic matter in these shales can be extracted with certain solvents for petroleum.

The carbonaceous matter in oil shale that changes to oil on destructive distillation is called kerogen. The composition and constitution of kerogen have long been of interest to geologists and others. The difficulties of separating kerogen from its inorganic environment without fundamental changes in the composition of the kerogen prevented chemical analysis for many years. The task was accomplished first by Horne and Purdy,⁴ of the Bureau of Mines, in 1925 by exhaustive solution of the mineral matter with hydrochloric and hydrofluoric acids. In 1892 Mills⁵ had deduced the composition of the kerogen of Scottish shale from study of the shales. In 1939 and 1941 Down and Himus⁶ reported results of their study of the chemical constitution of kerogen.

The practical limitations of oil-shale utilization stem from the nature of the material. In the United States, oil shale ranges in assay value (potential oil yield) from less than 15 to more than 60 gallons to the ton of shale. Deposits large and rich enough to warrant utilization range in assay value from about 25 to 45 gallons of oil to the ton. In round figures, the products of oil shale retorting are 10 to 20 percent oil, 25 to 30 percent water vapor and gas, and 50 to 65 percent spent shale. Disposal of the large quantity of spent shale is a major problem and a serious expense item, and large volumes of retort gases may be a nuisance because of the presence of oil fog or other deleterious constituents.

Mining methods, oil-producing processes and equipment, and auxiliary items must be chosen with full consideration for these conditions, which set the technical and economic limitations of oil-shale utilization.

EARLY HISTORY OF OIL-SHALE UTILIZATION

Bacon and Hamor⁷ state that about 1680 a patent was taken out of England for making pitch and tar from pit coal and that as early as 1761 oils were distilled from black bituminous shales for medicinal purposes. The possibilities of producing petroleumlike products from oil shales do not seem to have been recognized until 1830, when Laurent (in France) obtained paraffin by distilling oil shale. The French oil-shale industry really began in 1838, with the perfection of a process developed by Selligne. The French industry grew in importance

¹ Gavin, Martin J., *Oil Shale, an Historical, Technical, and Economic Study*: Bureau of Mines, Bull. 210, 1924, p. 26.

² American Society for Testing Materials, A. S. T. M. Standards 1942, pt. III, Standard Definitions of Terms Relating to Petroleum: A. S. T. M. designation D 288-39, 1942, pp. 269-270.

³ Ashley, G. H. *Cannel Coal in the United States*; Geol. Survey Bull. 659, 1918, p. 11.

⁴ Guthrie, Boyd, *Studies of Certain Properties of Oil Shale and Shale Oil*: Bureau of Mines Bull. 475, 1938 (ch. VIII isolation and Analysis of Oil Shale Kerogen, by J. W. Horne and W. W. Purdy, pp. 105-123).

⁵ Mills, E. J., *Destructive Distillation*: 4th ed. London, 1892, p. 50.

⁶ Down, A. L., *The Analysis of the Kerogen of Oil Shales*: Jour. Inst. Petrol. (London), vol. 25, April 1939, pp. 230-237; December 1939, pp. 813-819. Down, A. L., and Himus, G. W., *A Preliminary Study of the Chemical Constitution of Kerogen*: Jour. Inst. Petrol. (London), vol. 27, December 1941, pp. 426-444.

⁷ Bacon, R. F., and Hamor, W. A., *The American Petroleum Industry*: New York, vol. 2, 1916, p. 808.

until 1864, when low-priced petroleum products from the United States caused a decline from which the industry has never fully recovered.

The oil-shale industry in Scotland dates from 1851, when James Young and two associates erected a plant for the production of oil from boghead coal or torbanite. These deposits became exhausted in 1862, and since then the oils obtained in Scotland have been produced almost entirely from oil shales.

Oil shale has been retorted in Australia at intervals since about 1856, and attempts are still being made to achieve a satisfactory solution of the technical and economic problems, with little success.

PRESENT STATUS OF OIL-SHALE UTILIZATION

Oil shale is now being retorted in Scotland, Japan, Estonia, Germany, France, Australia, and other countries. None of them has nearly enough petroleum output even for normal peacetime needs, and the cost of transportation adds substantially to the cost of imported petroleum products. Nevertheless, oil-shale utilization in these nations is supported by substantial subsidies. For example, the subsidy for motor fuel made from indigenous materials (oil shale, coal, or alcohol) in the British Isles is approximately 14.9 cents a U. S. gallon; and in France, when the selling price of a gallon of gasoline was 7.5 francs, including 6 francs in duty and internal fiscal taxes, gasoline made from shale was exempt from the taxes.⁸

At a conference on oil shale and cannel coal in Glasgow, Scotland, June 1933, papers were presented by representatives of the principal shale-oil-producing countries of the world. The published proceedings⁹ comprise the best single source of information on the technical achievements in this field and also give accounts of the historical developments of oil-shale retorting in various countries.

Until recently oil from shales has been a *r  serve* for future needs of fuel in the United States, and shale oil has never been produced here in quantities large enough to establish oil-shale utilization as a sustained industry. The total output of shale oil in the United States has been insignificant in comparison to demands for liquid fuels, and only small experimental quantities have been produced in the United States since the Bureau's experimental plant was closed in June 1929.

From time to time, various organizations and individuals have made studies with a view to the future, and the Bureau of Mines has had an important part therein. Although articles describing the Bureau's investigations have been printed in various publications, a brief r  sum   of various aspects of oil-shale utilization may be useful to indicate what has been done and what remains to be accomplished before it can become established on a sound basis in the United States.

PETROLEUM SITUATION IN THE UNITED STATES IN 1916

In view of the bountiful supply of petroleum and adequate facilities for supplying demands for petroleum products in the United States until recently, a useful purpose may be served by recalling conditions in the petroleum industry in 1916, when the Bureau of Mines decided to study the technologic and economic phases of oil shales of the United States as a supplement to petroleum.

The following statement, published by the Bureau in 1916, gives a good perspective of conditions in the petroleum industry of the United States at that time. This statement is an excerpt from the preface to bulletin 114,¹⁰ and is by the late Van. H. Manning, former Director of the Bureau of Mines.

Losses in utilization (of petroleum) include not only the actual waste in the use of petroleum and its products, but the making of excessive amounts of less desirable products in manufacturing the products that are in the most demand. For instance, gasoline is obtained chiefly from petroleum, containing a large proportion of paraffin hydrocarbons, but many of these petroleum yield only small percentages of gasoline under the old distillation methods, so that their utilization in this way has been uneconomical and wasteful. By "cracking" processes the yield of gasoline has been largely increased, but the yield should be still larger. It is estimated that the output of gasoline by the Burton process,

⁸ Siegler, J., The Bituminous Shale Industry in France: Paper presented at Conference on Oil Shale and Cannel Coal Glasgow, Scotland, June 1938, and published in proceedings.

⁹ Institute of Petroleum, Oil Shale, and Cannel Coal; Proceedings of a conference held in Scotland, June 1938, London, 1938.

¹⁰ Rittman, W. F., Dutton, C. B., and Dean, E. W., Manufacture of Gasoline and Benzene-Toluene from Petroleum and Other Hydrocarbons: Bureau of Mines Bull. 114, 1916, 268 pp.

the cracking process used by the Standard Oil Cos., amounted in 1915 to 3,000,000 barrels,¹¹ but this was equivalent to 18,000,000 barrels of Mid-Continent crude oil. In other words, only about one-sixth of the bulk of an average paraffin-base petroleum from the Mid-Continent field was converted into gasoline by the most efficient cracking process in commercial use in 1915.

Some striking facts regarding present conditions in the petroleum industry with especial reference to the increased consumption and existing high price of gasoline are given in a report made by the Secretary of the Interior to the United States Senate under date of February 2, 1916, and published as Senate Document No. 310.

The estimated production of gasoline in the United States in 1915 was 41,600,000 barrels, and the amount exported in that year was 6,500,000 barrels, leaving a difference of 35,100,000 barrels for consumption in this country. These figures compare with a production of 12,900,000 barrels, exports of 1,640,000 barrels, and an available difference of 11,260,000 barrels in 1909; and a production of 6,920,000 barrels, exports of 1,640,000 barrels, and an available difference of 6,280,000 barrels, in 1904.

In regard to the consumption of gasoline, the Secretary of the Interior says: "The new uses of gasoline and kerosene (coal oil) are of comparatively minor importance. The consumption of gasoline has been due to the tremendous growth of old uses.

"The principal uses of gasoline today are as follows: (a) Automobiles, motor-boats, motorcycles, and aircraft; (b) stationary internal-combustion engines; (c) traction and other portable units; (d) general industrial and household uses.

"None of these has yet reached a stage where the future can be accurately forecast."

The Secretary states that the recent extraordinary rise in the price of gasoline is due to the following causes: The increased consumption of gasoline within the United States, which is estimated to have been 25 percent greater in 1915 than in 1914; the increase in exports; the depletion of gasoline stocks due to increased domestic and export demands; the decreased production of crude oil containing a large percentage of gasoline; the increase in the price of crude oil; and financial influences.

BUREAU OF MINES WORK ON OIL-SHALE UTILIZATION

Bureau of Mines work on oil shales and shale oils may be divided into two parts. During the first part (from the beginning of the investigation in 1916 to 1925) the possibilities of commercial development of oil-shale utilization were studied by means of laboratory studies, field surveys, and economic discussions. During this period much valuable fundamental information was obtained, and several reports were published. The foundation also was laid for the second part of the Bureau's work, beginning in 1925, when expansion in the scope of the study from the laboratory scale to experimental operation with units of commercial size was made possible by a congressional appropriation, as of March 4, 1925, of funds for constructing an oil-shale retorting plant. The plant was built near Rifle, Colo., in 1925 and was operated until June 30, 1929, when activities were terminated and the plant was dismantled. A total of approximately 6,000 tons of oil shale was mined and retorted under experimental conditions with commercial-scale equipment, and 3,600 barrels (150,000 gallons) of shale oil was produced. The Bureau has done no experimental work on oil shale since these tests were discontinued.

The laboratory and field work done before 1925 had revealed certain properties of American oil shales and shale oils which indicated that, with the types of oil shale most abundant in the United States, commercial retorting experience in other countries (Scotland, for example) would not serve as a basis for obtaining relationships between laboratory and large-scale production of shale oil. Consequently, it seemed that experiments should be conducted in the United States using units of commercial size operated as a pilot plant.

In December 1916 President Wilson set aside two large areas of oil-shale land in Colorado and Utah as future sources of fuel for the United States Navy. Reserve 1 is in western Colorado, on the Denver & Rio Grande Western Railroad, north of the Colorado River, between Grand Valley and Rifle, Colo. Naval Oil Shale Reserve 2 is in Utah, east of the Green River, about 50 miles north of Elgin,

¹¹ 344,013,000 barrels, all companies, in 1941.

which is also on the Denver & Rio Grande Western Railroad. From the knowledge then at hand, based on laboratory investigations, there was no definite assurance that the oil in these naval oil-shale reserves could be extracted readily in an emergency by retorting methods that had been successful with oil shales in other countries.

Reports of the Federal Geological Survey had established that the oil-shale deposits were of immense magnitude and that their potential oil yield was much more than the total quantity of petroleum produced from oil fields of the United States. However, only very small quantities of oil actually had been extracted from oil shales of the United States, despite numerous attempts.

A naval fuel-oil committee appointed by President Coolidge in 1924 to study the problem of obtaining an adequate and dependable supply of fuel oil for the Navy recommended that the Bureau of Mines study oil shale to determine the feasibility of using it as a source of fuel oil. This recommendation was a further indication of the uncertain knowledge of oil-shale retorting.

The Congress appropriated \$90,000, available March 4, 1925, for construction of an experimental oil-shale plant and an additional \$80,000 for operation of the plant during the fiscal year ended June 30, 1927. The factors influencing choice of location and operation of the plant in 1925-27 are described in Bureau of Mines Bulletin 315.¹²

Additional funds were made available in February 1928 by congressional appropriation for altering the plant and for further studies of mining, retorting, and refining. Remodeling and reassembling of the plant were begun in March 1928, and retorting was resumed in June 1928 and terminated on June 30, 1929.

BUREAU OF MINES PILOT-PLANT OPERATIONS

Need for pilot-plant operations.—The conclusion that the two naval oil-shale reserves were of little significance as naval fuel reserves is based on the fact that at the time these reserves were established only an insignificant quantity of oil had been extracted from oil shale in the United States and with few exceptions this oil had been obtained in a number of small-scale devices found to be technically impractical. If a reserve is considered to be something set aside for future use as needed, the naval oil-shale reserves could not be considered to be naval fuel reserves because virtually nothing was known regarding the conditions necessary to obtain fuel oil from these shales. Due to this situation, the primary problem to be solved by the experimental mining and retorting program was to learn how fuel oil could be obtained from the shales on a large scale. The Bureau already had made laboratory studies and obtained information regarding methods of oil-shale retorting used throughout the world and had studied virtually all processes proposed in the United States for retorting oil shale.

Only two shale-retorting operations in the United States had proved to be successful, from a technical standpoint, on a large scale. One was the plant of Catlin Shale Products Co., Elko, Nev., which was operated on a fairly large scale for several months, and the second was the operation of the N-T-U Co., which had been technically successful in producing oil from impregnated shales near Casmalia, Calif. In this plant retorts of 40-ton capacity were used to treat the oil-impregnated Monterey shales rather than true oil shale. The Catlin Shale Products Co. had made motor fuels and lubricants that were sold to the general public. These projects evidently were not economically successful even at the prevailing high prices of petroleum products and were terminated.

In foreign countries the Scottish oil industry had the best record of sustained operation, and the Pumphreston or Bryson retort had gone through a period of some 70 years of development. It had been used not only in Scotland but also in France and in Spain and in modified form in Australia. Scottish operators considered it the most satisfactory retort ever used in that country.

Selection of retorts.—When the congressional appropriation became available, Bureau of Mines engineers decided, in accordance with the Naval Fuel Oil Committee recommendation, to erect one or two retorts of commercial size at a site near a deposit of representative Rocky Mountain shales. The retorts were to be operated (1) to determine the capacity of the retorting units under definite fixed conditions, using shales having a considerable range of richness, and (2) to establish the operating conditions suitable for most economical yields.

¹² Gavin, M. J., and Desmond, J. S., Construction and Operation of the Bureau of Mines Experimental Oil-Shale Plant, 1925-27: Bureau of Mines Bull. 315, 1930, 154 pp.

The definite objective of the program of mining, retorting, and refining was to obtain information rather than large yields. Consequently, retorts were operated at times under conditions known not to be conducive to highest yields, in order to establish limits of variation. Undoubtedly, larger tonnages of oil shale could have been mined and larger quantities of oil obtained if efforts had been concentrated on producing oil rather than on obtaining a broad mass of information.

The retorts used at the experimental plant were selected for suitability for the contemplated experimental work. Even if time and money had permitted, Bureau engineers had no intention of designing large scale retorting units. It was considered advisable to purchase retorts, already sufficiently developed, that would be most satisfactory for testing, on a large scale, the conditions that had been determined by laboratory study to be most suitable for producing maximum quantities of refinable products, and to modify these conditions to produce best results at lowest cost. Accordingly, the retorts were purchased with the following requirements in mind.

The retorting equipment should be flexible enough to permit such factors as distillation temperatures, distillation zones, and gas velocities to be altered readily or held constant; be mechanically simple and of rugged design and construction; be capable of handling shales of widely different quality; and be far enough advanced in development so that Bureau engineers would not have to work out details of design and construction.

The two retorts selected were an N-T-U retort and a single-unit Pumphierston retort. Choice of these two retorts provided two different types of retorting, namely, rapid retorting in a batch apparatus and slow retorting in a continuous process. The selection also provided one of the two technically successful American retorts and the most successful of those developed in European practice. It seems evident in retrospect that it would have been extremely short-sighted if the Bureau had undertaken a program to determine the best means of obtaining naval fuel oil from Green River oil shales and had not tried a retort with as long a period of successful operation to its credit as the Pumphierston. It would have been equally short-sighted to ignore the comparatively successful results obtained with the N-T-U retort in California. The state of knowledge of oil-shale retorting in 1925 is indicated by the outcome of the Bureau's experiments, which showed that the Pumphierston retort is unsuited to Green River shales, and some 40 runs of the N-T-U retort were made before moderately successful operation was obtained. There can be little doubt that, as a result of the Bureau's experiments, the Green River oil shales have advanced from their former status as naval oil-shale reserves to the category of naval fuel-oil reserves, and the time required to obtain fuel oil for the Navy from these oil shales has been reduced by at least 2 years.

Pumphierston retort—The Pumphierston or Bryson retort in commercial operation in Scotland is constructed in "benches" of 52 retorts of the kind purchased by the Bureau of Mines. The retorts are built in "sets" of 4 retorts each, 13 sets to the bench; 1 discharge hopper is common to two retorts, and four retorts are set in a common furnace served by 2 smokestacks. Each set of 4 retorts is separated from the next by fairly thick brick walls.

The experimental unit was purchased by the Bureau of Mines from A. F. Craig & Co. (Ltd.) of Paisley, Scotland. It differed from the construction of commercial installations in that it was a single retort surrounded on all sides by exposed brick walls; consequently radiation losses were proportionately larger than in commercial operation. To reduce the radiation loss, the brick walls below the vapor offtake were covered with asbestos blocks 1 inch thick.

The retort and its operation have been described adequately in the literature, and readers of this article may find essential information in Bureau of Mines Bulletins 210¹³ and 315¹⁴ and in the report of the Glasgow conference.¹⁵

Experimental operation of Pumphierston retort.—The construction and mode of operation of the Pumphierston retort permit variations in a number of conditions in retorting oil shale. The variable conditions include the nature of the shale, the average size of crushed shale, the rate of shale throughput, the temperatures in the flame passages, and the rate of steam input. Variations in these conditions affect the quantity of oil produced, the percentage of oil re-

¹³ Work cited in footnote 1.

¹⁴ Work cited in footnote 12.

¹⁵ Work cited in footnote 9.

covered based on laboratory assay, the quantity and composition of gas produced, and the quantity of ammonia produced.

In experimental operation of the Pumphierston retort, attention was directed principally to the study of factors that influenced production of shale oil at the lowest over-all cost per gallon. This problem involves many considerations; and, as has been stated, the primary object was to obtain information rather than supplies of oil. Therefore the retort was operated under a variety of conditions, some of which were known in advance to be undesirable for one reason or another. Such operating conditions were set up in the retort to determine the upper and lower limits of the range of desirable conditions; that is, the program was planned with the idea of determining the effect of varying, one at a time, as many of the conditions of operation as possible. Thus, information was obtained that may be important in future American oil-shale development.

Experience having indicated that coking shale will plug the Pumphierston retort, after August 1928 only shale from a 7-foot series of strata was charged to the retort. This shale showed virtually no tendency to coke, and laboratory assays of the shale charges to the retort ranged from 31.5 to 37.1 United States gallons of oil to the short ton of shale. During the operating period of the Pumphierston retort that began in August 1928, approximately 1,400 short tons of shale were charged. During the entire operation, beginning in September 1926, approximately 3,000 short tons of oil shale were charged to the Pumphierston retort. The charges ranged in assay value from 17 to 42.3 gallons of oil to the short ton of shale.

Results of experimental operation of the Pumphierston retort may be summarized as follows: Rates of retorting ranged from 5 to 9.5 short tons in 24 hours, and the average rate was 6 tons. During the period of operation beginning in August 1928, oil recovery ranged from 60 to 95.8 percent of the assay value, and approximately 29,000 gallons of oil were produced. During the entire period of operation of the Pumphierston retort, approximately 68,000 gallons of oil were produced.

The rate of steam input was varied between 33 and 120 gallons of water to the short ton of shale. The experimental operation indicated that from the standpoint of quantity of oil produced, the optimum quantity of steam is 70 to 72 gallons of water to the ton of shale for a charging rate of 5 tons a day; the optimum rate apparently is approximately 60 gallons of water to the ton of shale for a charging rate of 8 tons a day.

As a result of operations of the Pumphierston retort, the following conclusions appear justified:

(1) The retort gives a high yield of oil, some ammonia, and more than enough gas to maintain favorable retorting temperatures, when it is charged with noncoking shale from the Green River formation.

(2) Coking shales, such as those of the Green River formation will plug the retort.

(3) The retort appears to be capable of a sustained yield of 225 gallons of oil a day, when charged with 35- to 36-gallon shale.

N-T-U retort.—The N-T-U or Dundas-Howes retort is not so well-known as the Pumphierston and differs from it in that it is of the intermittent or "batch" type and exemplifies rapid distillation. It has been described in Bureau of Mines reports.¹⁰ The retort used in the Bureau's experiments consisted simply of a steel cylinder 23 feet tall lined with firebrick, supported by a structural-steel assembly on a reinforced-concrete foundation. Its internal diameter was 7 feet 3 inches at the bottom and 6 feet 10 inches at the top at the spring line of the dome, and it had a charging capacity of approximately 30 tons of crushed oil shale. It was closed at the bottom by a horizontal sliding door the full circumference of the retort and at the top by a charging door 2 feet 6 inches in diameter. Two 6-inch gate valves were fitted into the top to admit air and inert gas needed in the retorting process. In addition to the retort proper, the N-T-U equipment included pipes for leading gases and vapor from the unit through coolers and condensers, which also are part of the equipment for liquefying the oil extracted from the shale. An exhaust fan was provided to draw the vapors through the coolers and condensers.

The retort is charged by closing the bottom and dumping in oil shale through the charging door at the top. Retorting is started by building a wood fire on the shale, replacing the lid on the charging door, and starting the exhaust fan, which draws air downward through the valves on top of the retort and causes

¹⁰ Work cited in footnotes 9 and 12, see also Ind. Eng. Chem., 1928, pp. 784-791.

a combustion zone to move downward through the charge, burning the fixed carbon of the spent shale while a distillation zone precedes the combustion zone. After retorting has been started, a portion of the exit gas ("return gas") is mixed with the air passing into the retort. Proper regulation of the proportion of air and return gas is the most important factor in successful operation of this apparatus.

The return gas is almost inert, having a calculated heating value of less than 100 British thermal units a cubic foot. It comprises approximately 60 percent nitrogen, 20 percent carbon dioxide, and the remaining 20 percent above equal volumes of hydrogen, carbon monoxide, and hydrocarbons, with 1 percent oxygen. This return gas was mixed with air in a ratio of approximately 45 volume percent air to 55 percent gas. Under these conditions the mixed gas entering the retort contains about 10 percent of oxygen and, as the return gas contains only 1 percent oxygen, 90 percent of the oxygen entering the retort is consumed in combustion within the retort.

When the heated zone has traveled to the bottom of the charge, retorting has been completed, and the spent charge is dumped by pulling the door aside by means of a worm-drive mechanism.

Experimental operation of N-T-U retort.—The N-T-U retort was selected for experimental operation for two main reasons: (1) The N-T-U retort is fundamentally different from the Pumpherson retort in its construction and mode of operation, and (2) the retort had been used with apparent success from a technologic standpoint in processing a fairly large quantity of bituminous material in California; in fact, the N-T-U retort appeared to have the best record of past performance of any available retort that had been developed in America.

The reasons for selecting the N-T-U retort are given in detail in Bulletin 315.¹⁷ Results obtained with the retort have fully justified its selection.

As was true of the Pumpherson retort, the N-T-U retort sometimes was operated under conditions known in advance not to be advantageous, to obtain the information that such operation would yield. The last several runs of the retort were very satisfactory and indicate its capacity and flexibility. The poor yields and clinkering of the charge, characteristic of the earlier operations, were due not only to lack of experience with the retort and to insufficient control equipment, but also to the desire to establish the limits of operating conditions that would result in excessive clinkering. Originally it was thought that charges rich in coking shale must be retorted slowly to prevent clinkering of the entire mass of spent shale. The last run of the retort, which was completed in 24 hours from the time the fire was lighted until the spent shale was dumped, was made with the worst coking shale obtainable. Although about two-thirds of the spent shale was in the form of large clinkers, the retort was discharged easily.

Every variety and mixture of shale available at the experimental mine was used in the N-T-U retort. The charges ranged in richness from 15 to 52 gallons of oil to the ton of shale and in "coking" characteristics from nearly zero to the worst coking shale obtainable. All types of charges were retorted successfully.

During the entire period of operation of the N-T-U retort, 115 runs were made, approximately 3,200 short tons of shale were retorted, and approximately 81,500 gallons of oil were recovered. Oil recovery ranged from 36 percent to more than 100 percent of the Bureau of Mines assay value.

Yields of Pumpherson and N-T-U retorts compared.—Because the Pumpherson and N-T-U retorts differ in design and in method of operation, it is difficult to make a fair comparison between them from any viewpoint without considering many details. However, it may be informative with respect to the results obtained in the experimental operations of the Bureau of Mines to compare the charges and yields of the two retorts when both were charged with the shale that was mined especially for charging to the Pumpherson retort. This shale was mined from a selected bed of 7 feet of strata free of coking shale, because the Pumpherson retort was found unsuited for coking shale, even in small proportions, whereas every type of shale available at the plant was retorted successfully in the N-T-U retort.

The data on the Pumpherson retort in tables 1 and 2 apply to a 3-week period of operation and are considered representative. They are given for four times the average daily operation (4 average days) during the 3-week period. This

¹⁷ Work cited in footnote 12.

is done for the following reasons: In the construction of the Pumphierston retort in Scotland, four retorts are set in a common furnace and may therefore be considered to be a unit of Pumphierston construction. The capital cost of one such unit of four retorts is approximately equal to the capital cost of a 30-ton N-T-U retort. The quantity of shale retorted per day in four Pumphierston retorts in this operation would be approximately the same as one charge of the N-T-U retort.

The data on the N-T-U retort apply to one of four runs made with shale such as was charged to the Pumphierston retort.

The data in tables 1 and 2 indicate that the Pumphierston retort produces a slightly smaller percentage yield of oil containing a larger proportion of low-boiling compounds than the N-T-U retort and a small quantity of ammonia, and more fuel gas than is needed to heat the retort. The gas from the Pumphierston retort has a thermal value of approximately 300 British thermal units a cubic foot, and the gas not needed for heating the retort is available as fuel for other operations. However, the ammonia and the gas are produced at considerable expense for steam not incurred in the operation of the N-T-U retort. The large volume of gas (quantity not shown) produced by the N-T-U retort has no value as fuel.

TABLE 1.—Comparison of charges and yields from same shale in Pumphierston and N-T-U retorts

	Pumphierston retort ¹	N-T-U retort ²
Shale charges..... short tons.....	25.2	28.9
Assay value of charge..... gallons per ton.....	35.5	36.0
Steam added..... gallons of water.....	1,670	-----
Do..... gallons of water per ton of shale.....	66	-----
Oil yield..... total gallons.....	800	1,008
Do..... gallons per ton of shale.....	31.8	34.8
Do..... percent of assay.....	89.3	96.7
NH ₃ yield..... pounds, total.....	48	-----
Do..... pounds per ton of shale.....	1.9	-----
Do..... pounds per gallon of water.....	.03	-----
Gas yield..... cubic feet, total.....	100,000	-----
Do..... cubic feet per ton of shale.....	4,340	-----
British thermal unit per cubic foot.....	300	NIL

¹ The figures in this column represent 4 times the average daily operation during the 3-week test period in 1 retort at the Bureau of Mines Experimental Oil-Shale Plant.

² The figures in this column represent a single run of the N-T-U retort.

³ A portion of this quantity of gas was used in heating the retort. It supplied all of the heat applied to the retort, except the steam.

TABLE 2.—Comparison of oil retorted from the same shale in Pumphierston and N-T-U retorts

	Pumphierston retort	N-T-U retort
Specific gravity.....	0.887	0.911
°American Petroleum Institute.....	28.0	23.8
Sulfur (S)..... percent.....	.67	.71
Nitrogen (N)..... do.....	1.91	2.20
Pour point..... °F.....	80	90
Distillate of the oil:		
Distillate to 200° C..... percent.....	15.4	6.8
Do..... specific gravity.....	.796	.823
Do..... °American Petroleum Institute.....	46.3	40.4
Distillate, 200°-275° C..... percent.....	19.7	16.8
Do..... specific gravity.....	.854	.861
Do..... °American Petroleum Institute.....	34.2	32.8
Distillate to 275° C..... percent.....	35.1	23.6
Do..... specific gravity.....	.829	.850
Do..... °American Petroleum Institute.....	39.2	35.0
Residuum..... percent.....	64.9	76.5
Do..... specific gravity.....	.917	.930
Do..... °American Petroleum Institute.....	22.8	20.7

Summary of retorting results.—The experimental retorting of oil shale by the Bureau of Mines indicates that the Pumpherson retort can be used for retorting a portion of the oil-shale strata in naval oil shale reserve 1. However, it is not known definitely how large a portion of the entire oil-shale deposit can be processed without encountering difficulty due to coking and to plugging of the retort. After August 1928 only shale from a 7-foot bed of noncoking shale was charged to the Pumpherson retort. Probably not more than a 30-foot bed of shale could be retorted successfully because of the necessity for avoiding coking shale.

The Bureau of Mines found that the N-T-U retort was satisfactory for use with Green River shales, giving yields consistently as high as 95 percent of the assay value of oil shale, and that coking shale could be retorted with little difficulty.

Possibilities of more advantageous utilization of Green River oil shale can be foreseen. For example, it seems technically possible to make water gas from the spent shale of the N-T-U retort at slight cost. The N-T-U retort is especially suited for making water gas. In other retorting processes the spent shale must be brought to the incandescent state in a separate operation, whereas in the N-T-U retort the spent shale is in an incandescent state at the end of a run, and means for removing the water gas are an integral part of the retort. Moreover, quenching the spent shale by steam or raw water aids discharging of the retort and disposal of the spent charge and may assist materially in solving the problem presented by the evolution of gas from the spent shale when it is discharged into the cars for disposal.

The Fischer process for hydrogenating carbon monoxide may prove to be an efficient means of utilizing water gas as part of an oil-shale operation. If, as seems likely, the resulting hydrocarbon mixture is unsatisfactory as gasoline, it can be re-formed by thermal or catalytic processes or used for purposes for which it is better suited—Diesel fuel, for example. Crediting part of the value of the water gas to the retorting process may decrease appreciably the cost of N-T-U shale oil.

REFINING SHALE OIL

As a part of the experimental program, a shale-oil refining laboratory was established on the campus of the University of Colorado at Boulder, Colo., in cooperation with the State of Colorado. Small-scale cracking experiments were made on oil produced from the Pumpherson and N-T-U retorts, on topped shale and on fractions derived from distilling topped shale oil to coke at atmosphere pressure. Each type of material was cracked under a variety of pressures and other variables that influence cracking procedure.

The distillate boiling in the gasoline range obtained by distilling both types of oil at atmospheric pressure and the cracked distillate boiling in the same range were treated with refining agents in use at that time looking toward preparation of commercial gasoline from shale oil.

Samples of oil from both retorts also were sent to a number of petroleum-refining companies and private investigators for testing. Their reports, with preliminary results of the Bureau's work on cracking and treating, are published in Bulletin 315.¹⁷

This laboratory work indicated that shale oil from either the Pumpherson or N-T-U retort is inferior to the average petroleum as cracking stock or for refining, because of the drastic chemical treatment necessary to meet commercial requirements. Products suitable as motor-fuel constituents were prepared, but the indicated costs and yields were not encouraging from a commercial point of view.

As a result of experience gained in the work described in Bulletin 315,¹⁷ later experiments at the Boulder laboratory were more encouraging as to the possibility of making commercially satisfactory motor fuel from shale oil. Furthermore, the technology of cracking has improved since the work on refining shale oils was terminated in 1930, and new methods of treating light petroleum distillates have been developed to commercial success. Probably much better results could be achieved now in quality of products, yields, and costs by methods that have been developed or improved in the interim since the Bureau's investigations on shale oil ceased.

¹⁷ Work cited in footnote 12.

N-T-U shale oil evidently is more closely related to kerogen than the products of other retorting processes; that is, it has undergone comparatively little secondary decomposition. Consequently, the oil contains only a small proportion of components boiling in the range of gasoline volatility. A mild cracking treatment—that is, viscosity breaking—might increase the yield of gasoline without undue decomposition of the remainder of the oil into gas and coke.

Another and more fundamental approach to the problem of manufacture of commercial products from shale oil would be fractionation, by distillation and by solvents. The newer techniques in this field apparently have not been applied to shale oil in the United States, and some surprising results might come from such a study. Uses for large quantities of phenol, cresylic acids, higher olefins, and other chemicals have been created during the past few years, and the tar acids and tar bases (caustic and acid solubles) of crude shale oil and its distillates and cracked products may be found to be commercially valuable.

COMMERCIAL CONSIDERATIONS

The commercial possibilities of oil-shale utilization must be evaluated on available information regarding the supply of raw material (oil shale), the cost of manufacture of commercial products, and the actual and potential demand for products. A discussion of these aspects of oil-shale utilization follows:

WINCHESTER'S ESTIMATE OF OIL-SHALE RESERVES OF THE UNITED STATES

The late Dean E. Winchester, who had wide experience in field examination of oil shales, first as a Government geologist and later as a consulting geologist, estimated the oil shales of the United States and their possibilities as sources of oil. The following discussion, including table 3, is adapted from his estimate.¹⁸

Winchester subdivided the oil shales of the United States into three classes; Tertiary oil shales of the Rocky Mountain region, Devonian black shales of the Eastern States, and cannel shales of the Eastern States coal measures. His estimate was based on the consideration that differences in the three classes of oil shales, in regard to accessibility to markets, cost of mining, loss in mining, and other factors that determine their utility, influence in varying degrees the estimate of the quantity of each class of shale that may be mined and treated at a time when average well oil is valued at \$5 to \$6 a barrel. These considerations obviously affect the estimate of the total amount of oil recoverable from the shales.

Tertiary oil shales.—The present remoteness of these shales from markets and the probably added cost of mining due to the possible necessity of using underground mining methods indicate the following limiting factors in making the estimates:

No oil shale was considered minable if it was less than 1 foot thick or if it would yield less than 15 gallons of oil to the ton or less than 3,000 barrels of shale oil per acre of shale land.

On that basis, a shale stratum 4 feet thick and yielding 15 gallons of oil per ton of shale or a stratum 1 foot thick yielding 60 gallons of oil per ton is minable.

To be ultraconservative, Winchester assumed, also, that not more than 60 percent of the shale in the ground would reach the retorts and be treated, although in the best operations, using the most economic, large-scale mining methods, the percentage doubtless would be larger. In fact, Winchester considered it was not at all impossible that as much as 95 percent of the minable shale would be treated.

Devonian black shales.—A large percentage of the Devonian black shales of the eastern United States are near the surface and can be mined by open-cut methods. In addition, the shales are near markets, supplies, and labor, thus enhancing their value and making it probable that thin strata and lean shales can be worked. The following limiting factors were used in preparing the estimates:

¹⁸ Winchester, D. E., The Oil Possibilities of the Oil Shales of the United States: Federal Oil Conservation Board to the President of the United States, appendix I, report II, January 1928.

TABLE 3.—*Estimate of oil recoverable from oil shales*¹

[Thousands of barrels of 42 gallons]

State	Total oil	Recoverable oil
Tertiary oil shales:		
Colorado.....	79,625,998	47,625,598
Nevada.....	6,039	3,623
Utah.....	48,800,000	25,680,000
Wyoming.....	3,044,000	1,826,400
Total Tertiary oil shales ²	125,476,037	75,335,721
Devonian black shales:		
Indiana.....	7,680,000	6,912,000
Kentucky.....	10,978,560	9,880,704
Total Devonian black shales ³	18,658,560	16,792,704
Cannel shales:		
Pennsylvania.....	13,800	8,280
West Virginia.....	13,800	8,280
Total cannel shales.....	27,600	16,560
Grand total.....	144,162,197	92,144,985

¹ Source: Winchester, Dean E., *The Oil Possibilities of the Oil Shales of the United States*: Appendix I, Report II of the Federal Oil Conservation Board to the President of the United States, January 1928, Washington, D. C., 1928.

² This estimate does not include small amounts of oil shale known or reported in the States of California, Montana, and Oregon.

³ No estimate is made for the States of Ohio and Tennessee, although it is recognized that undoubtedly there are areas of minable oil shale in these States.

No shale was considered minable if it was less than 1 foot thick or if it would yield less than 10 gallons of oil to the ton of shale or less than 2,000 barrels of oil to the acre. Only oil shale that might be mined by open-cut or steam-shovel methods was considered in making the estimates; consequently, it was estimated that 90 percent of the shale in the ground would reach the retorts for treatment.

Cannel shales of the coal measures.—In Pennsylvania, West Virginia, and Missouri there are numerous deposits of cannel coals and cannel shales. The latter are probably high-ash cannel coals. The deposits are characteristically lenticular and local. It was assumed, in making the estimates, that not more than 60 percent of the cannel shale in the ground would reach the retorts.

Winchester's estimate indicates that the shales in Colorado, Utah, and Wyoming could yield 75,000,000,000 barrels of oil and the shales in Kentucky and Indiana nearly 17,000,000,000 barrels. In contrast to these figures, the total quantity of petroleum produced in the United States from 1859 to 1941 was 25,000,000,000 barrels, of which nearly 30 percent was produced from 1936 to 1941, inclusive. Thus it is evident that the supply of raw material is ample.

COST OF MINING OIL SHALE AT RULISON, COLO.

The small size of the Bureau of Mines mining operations and the brief duration of the work did not permit the engineers to obtain a very definite idea of the cost of mining oil shale on a commercial scale. However, information derived from the mining operation, plus experience in large-scale mining of other materials, affords a basis for estimating oil-shale mining costs. E. D. Gardner and C. N. Bell¹⁰ have supplied the data in table 4, which estimates the costs of mining oil shale from naval oil shale reserve 1 near Rulison, Colo., the source of the shale used in the Bureau's experimental operation.

Estimates of mining costs were calculated on wages paid and prices of equipment and supplies in 1931. Gardner and Bell state that wages in western Colorado have risen approximately one-fifth and prices of equipment and supplies about one-third between 1931 and 1942 and that the costs in table 4 should

¹⁰ Gardner, E. D., and Bell, Charles N., *Proposed Methods and Estimated Costs of Mining Oil Shale at Rulison, Colo.*: Bureau of Mines, Inf. Circ. 7218, 1942, 59 pp.

be multiplied by 1.22 to raise them to the 1942 level. Amortization of capital charges in 15 years, with interest at 6 percent, plus allowance for replacement and repair of machinery, is assumed.

TABLE 4.—*Estimates of costs of mining oil shale near Rulison, Colo.*¹

Depth of bed	20 feet	20 feet	44 feet ²	106 feet ³	106 feet ³
Gallons per ton, average	44.3	44.3	35.4	⁴ 23.8	⁴ 23.8
Tons per day	2,000	4,000	5,000	10,000	10,000
Estimated cost of mining, per ton ⁵	\$1.004	\$0.964	\$0.712	⁶ \$0.576	⁷ \$0.538

¹ Gardner, E. D., and Bell, C. N., Proposed Methods and Estimated Costs of Mining Oil Shale at Rulison, Colo. Bureau of Mines Inf. Circ. 7218, 1942, 59 pp.

² Including 20-foot bed.

³ Including 44-foot bed.

⁴ Allowing for 10 percent dilution, with lean shale.

⁵ Based on 1931 costs; multiply by 1.22 to increase to 1942 levels.

⁶ Using branch raises.

⁷ Using scraper system.

COST OF AN OIL-SHALE PLANT OF COMMERCIAL SIZE

The following estimates of the capital requirements for an oil-shale mine and retorting plant are based on the premise that such a plant should yield at least 5,000 barrels of shale oil a day, to provide a reasonably wide base for spreading the costs of supervisory personnel and other general expense. With reference to naval oil shale reserve 1, near Rulison, Colo., this scale of operation would require mining 10,000 short tons a day from the 106-foot bed, or 6,250 short tons a day from the 44-foot bed (table 4).

The following calculations indicate that it would be preferable from a cost standpoint to mine the 44-foot rather than the 106-foot bed. Which plan would be advantageous in the long run would have to be decided according to circumstances at the time. Calculations for an oil-shale operation on a commercial scale adjacent to the naval oil-shale reserve are based on mining the 44-foot bed at the rate of 6,250 short tons a day.

Cost of mining.—The average assay value of the 44-foot bed of oil shale is 35.4 gallons of oil to the short ton. Assuming that retorting will yield 95 percent of the assay value, 6,250 tons of shale would yield 5,000 barrels of shale oil a day.

In table 4 the cost of mining the 44-foot bed of shale at the rate of 5,000 short tons a day is estimated at \$0.712 a ton (\$0.869 a ton, 1942 basis), which is equivalent to \$0.89 a barrel of oil produced (\$1.08 a barrel, 1942 basis). For the purposes of this discussion, it is assumed that the cost per ton of mining 6,250 short tons a day from this bed would be the same, interest and amortization of the additional investment in equipment being offset by the reduction in overhead and general expenses. The total cost of the mining plant is estimated at \$1,000,000 (\$1,300,000, 1942 basis).

If the shale is to be obtained by mining the 106-foot bed (table 4), 10,000 tons a day will be required. Assuming, as before, that retorting will yield 95 percent of the assay value, 10,000 tons of shale would yield 5,380 barrels of shale oil a day. The cost of mining is estimated at \$0.538 a ton (\$0.656 a ton, 1942 basis), which is equivalent to \$1 per barrel of oil produced (\$1.22 a barrel, 1942 basis). The total cost of the mining plant is estimated at \$1,600,000 (\$2,100,000, 1942 basis).

Cost of retorts.—Assuming that a 40-ton N-T-U retort can be operated on a 24-hour cycle and allowing 10 percent of retorting capacity to provide for retorts out of service because of repairs and other contingencies, 172 retorts, each of 40 tons charging capacity, would be needed. The estimated cost of each retort is \$20,000, or a total of \$3,500,000. This figure includes tracks and steel gondolas or hopper-bottom cars of 40 tons capacity for disposal of spent shale. These cars cost approximately \$2,500 each, and weigh about 22 tons.

If 10,000 tons of shale a day are to be retorted, 275 retorts of 40 tons capacity will be needed, and the total cost is estimated at \$5,500,000, including facilities for disposal of spent shale.

Cost of auxiliary equipment.—Power plant, mechanical shops, office building, laboratory facilities, and other auxiliaries, including living quarters for em-

ployees, are estimated to cost \$1,000,000 to \$1,400,000. Living quarters for employees and their families may be a large item of expense because the better shale deposits are in relatively inaccessible places.

Summary.—The estimates are summarized as follows:

Size of operation:		
Shale to be retorted.....	{ 6,250 tons a day 5,000 barrels a day	10,000 tons a day
Oil to be produced.....		5,380 barrels a day
Capital investment:		
Mining.....	\$1,300,000	\$2,100,000
Retorts.....	3,500,000	5,500,000
Other.....	1,000,000	1,400,000
Total.....	5,800,000	9,000,000
Per ton of shale a day.....	925	900
Per barrel of shale oil a day.....	1,160	1,670

These calculations are based on production of shale oil only. If the shale oil is to be cracked and refined for manufacture of automobile gasoline and byproducts, additional capital expenditures will be required.

On the basis of these capital costs, with amortization of cost of retorting equipment in 10 years and allowances for maintenance, it is estimated that the total cost of a barrel of shale oil would be \$1.75 if the 44-foot bed were to be mined at the rate of 6,250 tons a day, and \$2 a barrel if the 106-foot bed of shale were to be mined at the rate of 10,000 tons a day. The economies in large-scale mining and other operations are overbalanced by the greater richness of the 44-foot bed and the consequent smaller investment in retorts and other capital facilities. There is also substantially greater labor cost per barrel of oil in retorting the leaner shale of the 106-foot bed.

MANUFACTURE OF GASOLINE FROM SHALE OIL

Wherever specific figures are used in the following estimates, they are based on an assumed cost at \$1.75 a barrel of 42 gallons of N-T-U oil from Green River shale at Rifle, Colo. A second limiting assumption is that gasoline means automobile gasoline made by thermal cracking.

At the start of this discussion, it may be well to state categorically that careful technical analyses show that manufacture of gasoline from shale oil is not its best use under present circumstances. This viewpoint is supported by competent authority. Thus, at the Conference on Oil Shale and Cannel Coal, Glasgow, Scotland, June 1938, Dr. A. E. Dunstan, chief chemist, Anglo-Iranian Oil Co., London, which operates the oil-shale industry of Scotland, said:¹⁷

"It is absolutely necessary to develop a new technique for shale oils.

"It cannot merely be assumed that shale oil follows petroleum.

"Production of gasoline is uneconomic. New developments are being undertaken, as for example, the use of shale distillate as Diesel fuel."

It will be noted that Dr. Dunstan did not support his views in detail, and in the brief discussion he may have overemphasized the possibilities of oil shale as a source of Diesel fuel. However, his main thesis was stated clearly and specifically.

The principal reason for the difficulty of estimating the cost of making gasoline from shale oil, is that an estimate should be based on known processes, so that as many factual data as possible may be used, thus avoiding entirely conjectural answers. For this reason, processes developed for petroleum and never applied on a commercial scale to shale oil must be used as a basis for estimates. When oil-shale utilization is studied again by competent persons, means may be devised to make gasoline from oil shale in an economical manner by processes developed expressly for that purpose.

Another reason for considering shale oil to be unsuitable at this time for economic manufacture of gasoline is indicated in table 5, which shows that during the past several years approximately 500,000,000 barrels a year of petroleum fuel oils have been burned in this country.¹⁸ Nearly half of this quantity was straight-run fuel oil. In the present state of knowledge of shale-oil refining it seems likely that most, if not all of this fuel oil would have been more satisfac-

¹⁷ Work cited in footnote 12.

¹⁸ White, A. G., and others. *Crude Petroleum Products*: Reprint from Bureau of Mines Minerals Yearbook 1941, 1942, p. 71.

tory than shale oil as a source of gasoline and other petroleum products. Accordingly, it seems that shale oil should be considered as a source of fuel oil, residual and distillate, industrial and domestic, until the economic limit has been reached in converting petroleum fuel oil into gasoline, kerosene, lubricants, and other products. While the economic limit is being approached and shale oil and the remainder of the petroleum fuel oil are on a par as sources of gasoline and other products, improved processes for making commercial products from shale oil can be developed. During that time, also, markets can be developed for shale-oil byproducts, such as pyridine and similar nitrogen compounds and cresylic acid and other compounds.

TABLE 5.—*Fuel oil produced in the United States, 1940-41*¹

[Thousands of barrels of 42 gallons]

	1940			1941		
	Distillate fuel oil	Residual fuel oil	Total	Distillate fuel oil	Residual fuel oil	Total
Straight-run.....	130,477	102,548	233,025	132,307	117,728	250,035
Cracked.....	52,827	213,673	266,500	55,870	224,639	281,509
Total	183,304	316,221	499,525	189,177	342,367	531,544

¹ White, A. G., and others, *Crude Petroleum and Petroleum Products*: Reprint from Bureau of Mines Minerals Yearbook 1941, 1942, p. 71.

Despite the considerations that have been outlined, estimates of the cost of making gasoline from shale oil have been made, on the basis of the following assumptions:

1. The cost of N-T-U oil from Green River oil shale at a plant at Rifle, Colo., is \$1.75 a barrel of 42 gallons.

2. Thermal cracking is the only process available for augmenting the yield of gasoline above that present in the crude shale oil.

3. The objective is to make the maximum quantity of gasoline.

4. The cracking plant and refinery would be operated in conjunction with the oil-shale retorting plant. On this assumption the cost of auxiliary functions, laboratory, mechanical equipment, clerical assistance, food and housing for employees, and supervisory and administrative overhead, will be reduced considerably.

N-T-U oil contains only a small quantity of straight-run gasoline, of dubious quality. Consequently the most practical course would seem to be to charge the entire crude oil to a thermal cracking plant operated to produce gasoline, coke, and gas as ultimate products. A polymerization plant would be included in the refinery if the gas contains enough olefins suitable for polymerization.

The maximum yield of crude gasoline that can be expected from thermal cracking of N-T-U shale oil is 60 percent, or 25 gallons from a barrel of crude shale oil. The remaining 40 percent of the original shale oil will be converted to gas and coke, of no commercial value at the plant site because of transportation costs. Any gas not needed as fuel at and near the plant would be wasted, and the coke probably would accumulate on disposal dumps.

The cost of a cracking operation to a coke residue ranges from 25 to 60 cents a barrel of charging stock. Probably 40 cents a barrel would be a fair average. The cost of finishing the distillate to commercial gasoline would be 12 cents, a barrel of raw gasoline (7 cents for 25 gallons), with a treating loss of 8 percent (2 gallons).

Summarizing these estimates, a barrel of 42 gallons of N-T-U oil from Green River oil shale, produced at a cost of \$1.75, can be converted into 23 gallons of automobile gasoline at a cost of 47 cents—a total cost of \$2.22 for 23 gallons (9.7 cents a gallon).

If the cost of the shale oil is \$2 a barrel, as has been estimated for mining and retorting 10,000 tons a day from the 106-foot bed, the corresponding cost of gasoline would be 10.7 cents a gallon.

These estimates include allowances for all costs, except administrative overhead for the refining operations. The estimates by necessity are based largely on conjecture and are subject to wide variations, depending on attending conditions.

It does not seem to be economically desirable to convert 42 gallons of a fairly good liquid fuel (shale oil) into 23 gallons of automobile gasoline, at a cost of 47 cents and a loss of 19 gallons of liquid fuel.

In view of the circumstances that have been sketched briefly in the foregoing discussion of oil shale utilization, the Bureau of Mines believes that further exploratory and experimental studies should be made now, as a safeguard against a sudden sharp decrease in our available supplies of petroleum. It seems altogether likely that research on a pilot-plant scale, supported by laboratory experimentation done while there is yet time, would be much less costly and more effective than if efforts to utilize oil shale as a source of liquid fuels and other products were to be delayed until sudden necessity requires intense activity based on inadequate information regarding technical and economic factors.

STATEMENT OF A. C. FIELDNER, CHIEF, FUELS AND EXPLOSIVES SERVICE, BUREAU OF MINES

Dr. FIELDNER. I would like to point out that the oil obtained from oil shale can be used also as a raw material for the Bergius type of direct hydrogenation plant, such as is used for hydrogenating coal. As Mr. Kraemer stated, the oil obtained from oil shale is a decomposition product of an organic material in the shale, which the shale people call kerogen, and it is decomposed by heat in a manner analogous to decomposition of coal in its low-temperature distillation. And the oily product from shale, similar to the oily tars from coal, can be refined by hydrogenation to make a hundred percent gasoline of excellent quality; that is a means of stepping up this crude shale oil to motor fuel or an aviation fuel, but of course it can also be refined by present-day refinery methods to make the usual succession of materials and gasoline and Diesel oil, and fuel oil, and so on, as Mr. Kraemer points out. And furthermore, in a part of our shale oil industry we probably would use a good deal of that crude shale oil as a simple fuel oil on ships, to replace the fuel oil that now comes from petroleum, which is a better product for making gasoline. So, our first point of view, shale oil would probably be used as a fuel oil substitute for fuel oil obtained from petroleum.

Senator O'MAHONEY. I wish to announce to the audience that Dr. Fieldner is the head of the Fuels and Explosives Service of the Bureau of Mines; he has done notable scientific work for the Bureau in this division. Now, he can, I am sure, if he wishes, say a few words to this group of the studies that were undertaken at the direction of the Bureau of Mines—and I may say also, at the suggestion of the House committee of which Congressman Randolph is chairman—with respect to hydrogenation of coal. I am sure the audience would like a brief statement on that from you.

Dr. FIELDNER. Last year, when we had a hearing before the House committee, it was suggested to us that the Bureau could to good advantage send members of our staff to England particularly, to study the work that they had done on the hydrogenation of coal. The Bureau did send Dr. H. H. Storch, our principal physical chemist at the Pittsburgh experiment station, who is in direct charge of the coal extraction experimental work at that station, and accompanying him was Dr. W. C. Schroeder, who is here with us; he is Assistant Chief of the Fuels and Explosives Service of the Bureau of Mines. Together they visited the British plant in England where the imperial chemical industry has been making gasoline from coal—some 3,500 barrels a day—and also from coal tar. And they visited also the Scottish oil shale

plants where oil shales have been treated for many years; also the British research station.

The material they brought back is extremely valuable to us. They got the most hearty and sympathetic cooperation from the British Government laboratory as well as from the big imperial chemical industries, the largest group of chemical manufacturers in Great Britain. And they themselves told us that we ought to proceed and make certain experiments on our own fuels, because of their particular specific natures. They also told us some of their own difficulties in liquefying the coal there.

And I would like to say, in addition, at this point, that as the discussion comes up today you will probably present these different methods of getting liquid fuel from coal. We have our byproduct method, that is, high-temperature carbonization of coal, making coke and gas, which gives us a byproduct of 12 to 15 gallons of liquid fuel in the process of making coke and gas. And our low-temperature carbonization, which is as yet an infant industry in this country, which gives about twice as much liquid fuel in the production of solid smokeless fuel and gas. And these can be combined and supplemented with the processes for the complete liquefaction of coal, such as the Bergius process, which was invented in Germany and is in commercial use in Germany; probably more than half of the gasoline they are using is produced in this way.

Senator MURDOCK. Referring to the process that you mentioned, a plant of that kind would produce, would it not, a smokeless fuel which would to a large extent solve the problem that we have here in Salt Lake City, commonly referred to as the smoke nuisance? [Applause.] Isn't that right?

Dr. FIELDNER. Yes, Senator. A carbonization plant, either high or low temperature, will provide smokeless solid fuel, and as a byproduct liquid fuel ranging from, say, 15 to 35 gallons per ton of coal carbonized, depending on the process used. That liquid fuel could be cracked by our present refinery methods to yield about one-third gasoline, say, all together, probably 8 to 10 gallons of motor fuel per ton of coal carbonized. Or, if we had in combination with that a Bergius type of hydrogenation plant, we could turn all of that tar into gasoline by mixing it with coal dust and feeding it into this Bergius hydrogenation plant, where it is heated at high pressure in an atmosphere of hydrogen. There are a number of combinations that can be made between our processes and the coking processes. And you could also make the combination with low-temperature carbonization process. They all work together in many possible ways. We really do not know all the possibilities in connection with these different processes. As you say, Senator, it is quite feasible to make the process suitable for this community; shale would provide smokeless fuel and liquid fuel, also.

Senator MURDOCK. We think in Salt Lake City, Doctor, that we have probably the most beautiful city in the whole country, and about its only drawback is this smoke nuisance. Now, by the combinations you have referred to, or processes, in this vicinity we could get a supply of that smokeless fuel so badly needed, and also the other by-products for hydrogenation purposes. We would be killing two birds with one stone. We do hope that in the consideration of this question that due attention will be given to the problem that I mention.

Now, there is one other question I would like to ask you, and that is, in the production of gasoline from coal I think it has been brought out at our hearings that as high as 130 gallons of gasoline per ton can be produced from bituminous coal. Is that correct?

Dr. FIELDNER. Yes, sir; that is correct.

Senator MURDOCK. And that our coal here in Utah has even produced as high as 136 gallons of gasoline per ton. Is that true?

Dr. FIELDNER. That is correct, Senator.

Senator MURDOCK. Some of the members of the party I was with yesterday, when I made that assertion of 136 gallons per ton, were rather shocked, and I believe that they doubted what I said. But I think it has been thoroughly developed at our hearings that that quantity of gasoline may be produced from a ton of coal.

Dr. FIELDNER. That is correct, Senator. And it will be found in a statement that I made before the committee in Washington, some copies of which are available here, that gives the yields from some 15 different coals and lignites that were tried in different parts of the country.

Senator MURDOCK. Are they using similar coal in England to our western bituminous coal?

Dr. FIELDNER. No; the coal used in Billingham is very similar in analysis to the Pittsburgh coal—the Pittsburgh bed of coal that is mined in western Pennsylvania, West Virginia, and Ohio. However, the high volatile bituminous coals of Utah are, from a liquefaction point of view, somewhat easier to liquefy, in our experience, than the Pittsburgh coal that we started with at our plant in Pittsburgh. That coal is a little harder to liquefy than the coal here, and the yield is not quite as high. You have in certain of these beds in Utah unusually high yields of liquid byproducts; they contain a large amount of resinous materials, all of which contribute to these liquid byproducts.

Governor VIVIAN. Would that apply to Colorado coal as well?

Dr. FIELDNER. Yes; some of the Colorado coals. In fact, western Colorado is the eastern side of the Book Cliffs coal field, that crescent-shaped field that goes through Price and extends to Colorado; but it has not been developed in Colorado to the extent that it has here.

Governor VIVIAN. How would that apply to northern Colorado coals or southern Colorado coals?

Dr. FIELDNER. The southern Colorado coal—there is the coking coal in the Trinidad region, very similar in analysis to our Pittsburgh bed coal, but we have not tried it. We think that results would be similar to our Pittsburgh bed coal. We have actually liquefied some of the coal in the Denver field, just north of Denver, and it liquefies very readily.

Senator MURDOCK. I think we can assume, can we not, that the entire experience of England at the Billingham plant, all of their engineering data and so on, is presently available to the Bureau of Mines?

Dr. FIELDNER. Yes; Senator.

Governor MAW. In recommending that the units be 75- to 200-ton units—small units instead of larger ones—do you have in mind setting up several of them in order to experiment on a number of these processes and combinations? Is that what you have in mind, or are you recommending just one or two of them and deciding the processes in advance?

Dr. FIELDNER. We do not wish to recommend any particular retort at the present time without experimenting on the different types. Our proposal is to build typical kinds of retorts. There have been hundreds and hundreds of different processes proposed, but when these are analyzed they classify into perhaps three or four or five different types of processes, in which different principles are involved. Our proposal is to install one retort in those experimental plants involving each principle and then comparing the results obtained, both with respect to the yields obtained, the methods of operation for that particular type of retort, and the question of costs.

Governor MAW. The result would be, you would have a number of small retorts built in various parts of the country, is that right? Or are you planning on having them all combined in one?

Dr. FIELDNER. It might be desirable to combine several of them in one location and several of them in another, because we have different types of shale and different mining conditions. For example, there is strip-mining; obviously, we should do some work in that field, because that would be the cheapest form of mining in which we could find adequate shale for that purpose. Another location might involve underground mining, such as we practiced at Rifle in the previous experiments. We probably would do our coal and shale experiments in different localities.

Governor VIVIAN. You would probably have to, in Colorado.

Dr. FIELDNER. However, we could take some shale oil obtained in one locality and ship it to our Pittsburgh plant, and try out the shale oil, mixed with coal dust, for example, in our Bergius plant.

Senator O'MAHONEY. Thank you, Doctor Fieldner. We are very fortunate, the committee believes, in having present today the president of the Colorado School of Mines, Dr. Coolbaugh. Dr. Coolbaugh will be the last witness this morning. If you will be good enough to come forward, Dr. Coolbaugh, we will be delighted to hear from you.

**STATEMENT OF MELVILLE F. COOLBAUGH, PRESIDENT,
COLORADO SCHOOL OF MINES, GOLDEN, COLO.**

Dr. COOLBAUGH. Mr. Chairman, members of the committee, Representatives of Congress, I feel a little out of place. We have proved the case all over again very definitely; it ought to be handed over to the jury right now. In other words, if you may allow me to put in a personal statement regarding this, our Federal Government has been lax in research and taking up problems. This is somewhat off the record, but I saw specifications for materials put out in this war that were the same specifications that I reviewed in the last war; they hadn't been changed one iota from those that we had 20 or 25 years ago; there had been no research in the Government; the research has come through private industry. I am sure the States will endorse this bill most heartily. I think it is particularly appropriate that we should meet out in this western district. We have two-thirds of the coal reserves in the United States in the Rocky Mountain region, starting with the State of Wyoming, and the reserves standing out ahead of all others, with Colorado and Utah and North Dakota coming in close seconds. So, certainly, the raw material is here. You

have had quoted to you the shale oil reserves, and we have greater than two-thirds of the shale oil reserves in the western part of the country, the known reserves standing first for Colorado, second for Utah, and third for Wyoming. There are other oil shales but they are small in comparison. Now, certainly, on the basis of that, this is worthy of consideration, and it is worthy of consideration from this area. The fear of scarcity, they say, is the greatest incentive that we have to progress. Expressed in the old term, "Necessity is the mother of invention."

We are trying to impress upon this committee that it is a necessity. We want to impress upon Congress as a whole that we are up to the point here where something should start, and start now. Our thoughts today are focused upon the probable shortage of petroleum, due to the demands for synthetic rubber and for lubricants and for gasoline. We are all confronted with it; it isn't something in the future, that is coming, but we are confronted with it now. We can lay a whole lot of blame here, there, and everywhere, but that will never get us gasoline; it will never get us the lubricants that we need. But we have to go out and get them now, and get them quickly, for the war effort. Here we are achieving supremacy in the air, and one of our greatest shortages is high-octane gasoline. There are men grounded right today because we haven't enough high-octane gas to put them up and train them. Now, it is true that the Government is building plants—three in this area—one at Cheyenne, one at Parco, and one at Salt Lake City. But, even with those plants, we aren't going to reach the demand for high-octane gasoline if this war goes on very much longer.

Now, what are we going to do about it? What are we going to do about it? Of course, we hear many things. We hear it through the press, we hear it by people who speculate this way and that way. The quickest way to do something about it is a way that hurts most of us, and that is to take the gasoline that we use for nonessential driving and take it away from us, take these petroleum products away from us. The second way has been stated. We will have to find more new oil; you have appropriated some money for that. But you haven't gone far enough. I am receiving daily wires to get men who are qualified to search for new petroleum fields. The fact of the matter is, a movement is on foot to take technical men out of the Army; the number has been suggested from 1,000 to 2,000 technical men that have been allowed to get into the armed forces, the Army and the Navy, while we need them to locate and bring into production these new fields—our geologists, geophysicists, and petroleum producing men are needed to run the petroleum fields today. The day I left, I received information that 475 petroleum men were necessary to get the greatest production out of the present field we have now in the State of Wyoming. In other words, we must have petroleum, and we must have it quickly to meet the conditions. We have these three methods—from coal, from oil shale, and from oil sands. I have eliminated the gas proposition, because it is on the same declining curve that it is for oil. There are advantages in all of these. I am not going to take your time about coal; I don't know too much about it myself. I am not in the purely technical work at the present time; I know in a general way the work that has been done on it. I know what happened to Germany; I know of what is going on in England.

As to oil sands, the largest proposition on that in an experimental stage comes from the Athabasca sands in Canada. The Canadian Government is now operating an experimental plant of 3,000 barrels a day. You have oil sands in Utah, in the Uintah Basin, worthy of consideration from the standpoint of petroleum products.

Now, from what little I can give, I will try to confine it to oil shale, because about that field I know more than I do about the others. To me, there isn't a shadow of a doubt these oil shales should receive consideration No. 1. You have heard all about oil shales being treated to produce oil in other countries, not only our allies but our enemies. I will declare, I cannot see why America should not be as astute as the allies, and certainly as astute as its enemies. Germany is today producing oil from shales in the Estonian fields. Germany is credited with having put in 29,000,000 marks in reviving the oil-shale industry of France when she took over that country. The shale-oil production from Scottish shales has come up since this war started. Nobody has mentioned Manchuria; the Japs, when they get a little short on oil, have sense enough to get in there and produce some oil from the oil shale to replenish their vanishing supply from coal and other products. We have oil being produced in New South Wales.

Now, I am not going into the technical phases with your committee; the technical matters will take care of themselves in this country, if we start right. There are many places where, if we have to hurry this up, it can be hurried by supervision as the bill calls for, the supervision of this whole development scheme with our State agencies, and our private agencies, to bring this into a production state. Now, can we get, within a reasonable time, assurance that this work can start? We have had small pilot plants both for retorting and for refining. We have had some work done on the mining of this shale. There is a whole lot more to be done—a whole lot more to be done. There are stripping problems, there are crushing problems, there are tramping problems, there are other problems, all of which haven't been touched, and your Bureau didn't take those matters up to any great extent in this work. And then there is a newer phase of the work, and that is the refining of these products; there is an enormous field for improvement in refining.

I mustn't take any more of your time. I want to say in closing that we are just fortunate in being out here in the midst of things; we have the coal reserves of these United States right out here with us—it is just that they are undeveloped; we haven't them to where we can use them, but we do have the coal reserves. Two-thirds of the coal reserves are in the Rocky Mountain region, and much more than that of the oil shales are in the Rocky Mountain region. Are we going to be asleep at the switch? Pardon me for using that term, but as a government and as a people, are we going to be asleep at the switch and not look after the possibilities of improving our methods of getting petroleum on the declining curve?

I don't want to leave with you the idea this is necessarily just a war proposition. If the war is long enough, we will have to supplement. In other words, we are putting in something here that will extend over into peacetime, to replenish one of our most vital energy products that we have, and especially since we are going into the application of liquid fuels more and more and more. For the sake of the boys that

are in the field that lack high-octane gas—right now they are grounded for training purposes—certainly everything should be done to get more of our raw materials, petroleum raw materials. But in doing that, we certainly should not forget that a time factor is involved, and that this time factor should be this: we should start right at this present time to investigate further our production of liquid fuels from all of the sources at our disposal. [Applause.]

Senator O'MAHONEY. Dr. Coolbaugh, I was happy to note that you called attention to the fact that this bill provides for cooperation with State and private agencies to carry on the experimentation work. As the head of the Colorado School of Mines, do you care at this time to make any suggestion as to what such agencies could do to cooperate with the Bureau?

Dr. COOLBAUGH. I wouldn't want to confine that to a particular institution, Senator.

Senator O'MAHONEY. No; I didn't mean that.

Dr. COOLBAUGH. We have personnel in our institutions, some of the highest trained men that the country can present. We have equipment. If those men and equipment are not used for phases of development, we subject ourselves to the criticism that we are trying to build up a central agency or a Government bureau, where it becomes topheavy, to carry out all the phases of the work. Now, we can take our great research organizations of the country—and some of them are private, you understand—they would undoubtedly be very, very willing to go into certain phases of this development. Certain of the large petroleum companies have enormous resources in personnel and equipment. The fact of the matter is, they are the people that are doing much of the improvement today, especially in refining work; we could name a lot of private concerns. We have a good many of the institutions, just as you have here in Utah, where you have the Bureau of Mines plant. Now, the Bureau of Mines plant, the fuel-testing plant, happens to be established at Golden, Colo. Many institutions could take over certain phases of this work and be given responsibility of developing units, and we could progress very far indeed; then each of us wouldn't have to duplicate the other's work. When we don't cooperate this way, we are duplicating in very many instances and killing time. And again, may I say, it is a time factor.

Senator O'MAHONEY. If you will be good enough to give thought to that matter, I am sure the committee would be very happy to receive a memorandum from you. Of course, no action will be taken by the committee upon this measure until Congress reassembles in the middle of September, so there will be ample time for you to devote some of your vacation to additional work on this matter, and we would be very happy to hear from you.

Dr. COOLBAUGH. Thank you.

Senator O'MAHONEY. May I ask you this question? About the cost of producing oil from oil shale, have you given that any study?

Dr. COOLBAUGH. I just won't make a guess, except between limits, Senator. Certainly, with our resources here, there shouldn't be a hesitancy on the part of the Federal Government to put some money in this to work out these possibilities. I can give you dozens of things that ought to be done. What is a unit-size plant for shale? I don't think we know. As to the estimate of a dollar a barrel for crude shale

oil, I see it up to \$5 a barrel. I am certain that the cost lies in between those limits, but those costs will depend on conditions of handling. You saw out here yesterday, those handling costs are away down; all handling costs, overburden and everything else, runs 30 cents per ton. We have some handling costs for coal that are lower, by stripping, but what have we comparable in stripping for shale? Can we go into selective mining in shale and strip it, and handle it in a similar manner? Has it been determined? No. I am not so concerned with this question of costs right now. Are we justified in going ahead? Now, I turned the proposition down to a very large petroleum concern 18 years ago because we couldn't make our costs fit the present conditions at that time. Does that mean present conditions? Not at all. We have new methods of handling; we have cut our mining costs; we have cut our refining costs; we are making different products. And why shouldn't this be brought to bear on oil shale?

Senator MURDOCK. You think what is proposed in this bill—that is, the leadership of the Government, particularly the Bureau of Mines, in this field of experimentation—is an entirely proper Government function?

Dr. COOLBAUGH. Absolutely. Now, I would say this, that if they are going to become operating concerns, as has been mentioned in the press, I doubt that it is a legitimate function.

Senator MURDOCK. I agree with you thoroughly. But whenever the Bureau can utilize the research departments in our schools, or even privately owned, in the furthering of this program, it should be done. I do feel, however, that the time has not yet arrived when private industry can be depended upon to go out into this particular field, so far as profit is concerned. Therefore, it becomes, in my mind, the duty of the Government to assume the leadership which it will do under this bill, but without any idea of competition with private industry.

Dr. COOLBAUGH. I might mention this: I feel that all the companies will be willing to turn over the data they have.

(Supplemental statement submitted by Dr. M. F. Coolbaugh is as follows:)

THE PRODUCTION OF SYNTHETIC LIQUID FUELS FROM COAL AND OTHER SUBSTANCES

It is particularly fitting that meetings to discuss the possibility of production of synthetic liquid fuels from coals and other substances should be held in the Rocky Mountain region. It is here that over two-thirds of the reserves of coal and oil shale of the entire Nation are found and it is to these sources that we must look when the petroleum from wells fails to meet the demand.

Our thoughts today are focused upon the possible shortage of petroleum owing to the demands for it in the production of synthetic rubber and the tremendous consumption of both lubricating oils and internal-combustion fuels for the war effort, especially the consumption of high-octane gasoline. We are all familiar with the decline of production in petroleum wells, and we know that the new wells being brought in are not keeping up with this decline.

To meet this immediate emergency shortage we hear the following procedures advocated:

1. Further restriction of the use of oil and gas for nonessential civilian purposes.

2. Vigorous exploration for petroleum through the employment of geologists, geophysicists, and petroleum-production engineers to locate new oil structures and bring them into production. Congress has already appropriated a sum allocated to the United States Geological Survey for such exploration.

3. The production of synthetic liquid fuels from (a) coals, (b) oil shales, and (c) oil sands.

It is improbable that liquid fuels from these last-named sources will become vital factors in this war unless it lasts for several years. Three factors will cause the delay in production from these sources: First, there must be more small-scale and pilot-plant experimentation, as well as commercial-unit experimentation, before oils from these sources can become a commercial reality, and this takes time; second, there must be adequate supplies of construction material for the erection of plants; and, third, there must be adequate manpower to build and operate the plants.

1. *Oil from coals.*—There is a wealth of experimental data on the production of liquid fuels from coals, including production experience from the records of plants of this type both in England and Germany. Our own United States Bureau of Mines has carried on extensive laboratory and small-scale tests in this field. There is, however, much more experimentation to be done, especially as it relates to pilot-plant and unit-size commercial operation.

2. *Oil from oil sands.*—Oil sands should certainly be given some attention. Commercial production from this source is still in the experimental stage. There is, however, a plant being constructed by the Canadian Government treating Athabaska sands to produce approximately 3,000 barrels of oil per day. There are oil sands in Utah in the Uinta Basin that should receive consideration.

3. *Shale oils.*—I shall devote most of my attention to the subject of oil shale, since it is in this field that I have had the broadest experience. There is no doubt that oil shale is worthy of consideration, since we are having liquid fuels produced from this source at the present time by our allies and by our enemies, in Scotland and in New South Wales, and in Estonia, in Manchukuo, and in France. Since November 1941 the Germans are credited with having advanced 29,000,000 francs for the expansion of a French plant treating oil shale at Aun, France, which had previously been struggling for several years to get a commercial footing. In looking to this source for liquid fuels, America should not be less astute than its friends, and, certainly, not less astute than its enemies.

Unquestionably there is an abundance of oil shale in this country. The United States Bureau of Mines in Bulletin 415 quotes from a report written by Dean Winchester that there are 96,000,000,000 barrels of recoverable oil from shale in the United States, and that 75,000,000,000 of the total are to be found in Colorado, Utah, and Wyoming, of which 47,000,000,000 are found in Colorado alone.

The oil that can be produced from a ton of shale will vary between rather wide limits from 15 gallons low limit to 75 gallons for the high limit. Mining should be possible so that 35 to 40 gallons per ton could be recovered. This recovery can be effected without expenditure of any other energy than that produced from the shale. Approximately the same figure will hold for liquid fuels from different coals. If a larger number of gallons are produced from a ton of coal, energy must be furnished from an extraneous source.

A great deal of experimentation on oil shale and shale oil has already been made in this country by petroleum companies and also by the United States Bureau of Mines at its pilot plant near De Beque, Colo., and at its refining experimental station at Boulder, Colo. Data have been collected in relation to commercial-size plants in Scotland and at Elko, Nev. The United States Bureau of Mines has recently published a bulletin on the mining of oil shale near Rulon, Colo. However, there remains much work to be done not only on the problem of mining the shale but on the costs of stripping, breaking, crushing, and tramping, and in addition there is the problem of disposing of the waste products. Although much experimental work has been performed on the production of oil from shale, so far as I am informed no comprehensive work has been performed on the newer methods of refining as they would apply to the oil obtained from this source. This will require both laboratory and pilot-plant testing.

Serious experimentation should be undertaken to determine a unit-size plant for operation upon this material. Specifically, that is what the bill now under consideration calls for. Experimentation to determine the economics of combined retorting and refining should be undertaken. Also, careful consideration should be given to the utilization of the highly unsaturated liquids and gases produced in oil-shale retorts. There is no evidence that oil from oil shale, when subjected to proper refining, will give inferior products. Indeed, they may be found to be superior.

One could make a great many worth-while suggestions regarding experimentation not only in the field of oil shale but also oil sand. If, however, funds are available for such experimentation these problems will develop, and their solutions will be effected as the work progresses. Laboratory testing should go hand in hand with the work of the demonstration plants, so that all of the difficulties of the unit-size plant operations can be corrected.

That part of the proposed legislation which authorizes cooperation with other Federal, State, and private agencies is very important. Many institutions of higher learning have carried on experiments in the field of oil shale. They have the personnel, equipment and other facilities to carry the work further. The petroleum industry itself has been aware of the possibilities of oil from shale and has spent much money in an endeavor to produce commercial oil from this source. Every effort should be made to collect and analyze all existing data on the subject, thereby eliminating duplication of efforts and speeding results.

It is my feeling that there should be the most complete cooperation in this testing work among the Federal Government, State and private agencies, and petroleum companies, both large and small. Each should benefit by such cooperation. Any attempt on the part of the Federal Government to enter into competitive production of liquid fuels would be particularly unfortunate, especially at the present when the emphasis is being placed upon individual as well as national independence.

In closing I wish to state that I am endorsing most heartily this proposed legislation. I feel that in past years our Government can be criticized for its lack of stimulating experimentation to develop our great resources. The production of liquid fuels from coal and other sources has its greatest possibilities after the war when it can supplement our declining petroleum reserves. The work of testing should be started at once, not only as a national defense and wartime measure but as a peacetime necessity.

Senator O'MAHONEY. Thank you very much, sir. The committee will now stand in recess until 2:30.

AFTER RECESS

Senator O'MAHONEY. The committee will now come to order, please. The Chair has just received a letter from Mr. Robert E. Wilson, president of the Pan American Petroleum & Transport Co. He was to have been here today to have given testimony with respect to this bill. Unexpected developments have prevented his coming to Salt Lake City, and he has sent a statement which will be inserted in the record at this point.

STATEMENT OF ROBERT E. WILSON, PRESIDENT, PAN AMERICAN PETROLEUM AND TRANSPORT CO., NEW YORK, N. Y.

My name is Robert E. Wilson. I am president of the Pan American Petroleum & Transport Co. and subsidiaries. I am a graduate of the Massachusetts Institute of Technology and for several years was director of the research laboratory of applied chemistry and professor of chemical engineering at that school. During the war I was a major in the Chemical Warfare Service in charge of several lines of defense chemical research, including gas mask absorbents, protective clothing, etc. For about 15 years before coming to my present job, I was director of research for the Standard Oil Co. of Indiana.

Since I have been unable to arrange my schedule to attend any of the committee hearings, I have been requested to submit a statement of my opinion as to the desirability of the proposed bill authorizing the construction of semi-commercial units for the production of gasoline from nonpetroleum sources.

I am of the opinion that both Government research and industry research have a proper place in the development of future sources of gasoline. However, I believe it has been well established that competition between the two in research in the same field is undesirable because it either results in unnecessary duplication of work or in the discouragement of private competitive research in the same field. Also in a competitive field it is almost impossible to secure the full industry cooperation which is necessary in order to get the best results from Government research.

Under present conditions I believe that Government research, including the construction of semicommercial units in the field of coal hydrogen and shale oil recovery is proper and desirable, as little or no research is being done or seems likely to be done in these field by private industry in the near future. While the oil industry as well as Government recognizes that we are likely to have to resort to the use of such sources some time in the future, the need does not appear to the industry to be imminent enough to justify their expending the large sums required for such semicommercial developments. The Government results will, of course, be published and made available to all as a highly desirable background for further research and development by industry when and if the need for these sources becomes more imminent. At such time it would probably be desirable for the Government to retire from such parts of the field as industry was ready to follow up aggressively.

The wording of the proposed bill covers somewhat broader fields than those which I have above referred to as desirable. To make sure that Congress knows what it is authorizing I would favor limiting the authorization to these specific fields. Otherwise the bill seems to be as sound and desirable as a long-pull program. I question, however, whether it would be wise or desirable to attempt to secure the necessary equipment and technical men before the end of the war.

I have noted in one of the trade publications some discussion as to the desirable size of the proposed pilot plants. Some apparently feel that pilot plants costing in the neighborhood of two to three million dollars apiece would be adequate and others that pilot plants costing in the neighborhood of \$20,000,000 each would be necessary to get satisfactory results. While I have not had the benefit of hearing the detailed pros and cons in the matter, my own experience would lead me to definitely favor the smaller size. This not only makes a large saving in first cost, but the operation of too large semicommercial units requires so much raw material, manpower, tuning up time, and so forth, that experimental runs become very costly, it is hard to make modifications in the equipment, and one ends up with much less data of value on different raw materials and operating conditions than if the experimental plant were of more adequate size. In our industry the development of relatively small pilot plants has made great progress during recent years and the application of these results to large-scale design has developed into a real science.

In any case I think it would be highly desirable for a committee of technologists familiar with the various techniques involved to give serious study to this subject before accepting the conclusion that plants of the size of \$20,000,000 would be necessary or desirable.

Senator O'MAHONEY. It is now my pleasure to turn the meeting over to the distinguished Senator from Utah, Senator Murdock, who has been an active member of this special committee on western minerals from the date of its formation. I am very happy to be here in Salt Lake City and to give personal testimony of the great value of his work, not only to Utah but to this entire western Rocky Mountain region. Senator Murdock, will you take over? [Applause.]

Senator MURDOCK. I am very grateful to you, Senator O'Mahoney, for those very kind words. Our first witness this afternoon will be Mr. Bert Dyer, of the United States Geological Survey.

STATEMENT OF BERT DYER, GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

Mr. DYER. Mr. Chairman and members of the committee, Mr. A. S. Brown asked me to appear before this committee and make a statement as to the coal and oil shale reserves in Utah.

The coal reserves in Utah cover approximately 13,000 square miles, or 196 billion tons of coal. The coal crops extend from Colorado, north of the Denver & Rio Grande Western Railroad as far as Castle Gate, Utah, then extending south. These coals are mostly fairly high-grade gasoline coals and, if distilled by low-temperature distillation, will yield approximately 25 to 30 gallons of oil, 2,000 cubic feet of gas, and about 1,300 pounds of smokeless solid fuel.

Since mining first started, about 150 million tons of coal have been mined or a fraction of 1 percent of the reserves. Behind you is a map showing the coal crops of Utah. The brown lines indicate the coal outcrops.

In Utah we also have both the oil shales and the oil sands. The oil sands are found in the Uintah Basin and near the Colorado line south of the Uintah Basin, some on the San Rafael Swell and at Sunnyside, Utah. In one strip in the Uintah Basin there is an outcrop of about 12 miles; one strip is about $2\frac{1}{2}$ miles long and about $1\frac{1}{2}$ miles from the outcrop, which would yield 600 million barrels. The oil shales cover approximately $2\frac{1}{2}$ million acres, and these will yield from practically no oil up to 60 or 70 gallons to the ton.

Senator MURDOCK. If I may interrupt you, you say they cover an area of $2\frac{1}{2}$ million acres?

Mr. DYER. About $2\frac{1}{2}$ million acres. The richest oil shales are found close to the Colorado line, or south of the Gilsonite deposits in the Uintah Basin.

You may not have anybody here representing the coal reserves of Wyoming. Wyoming has about three times the reserves of Utah—about 650 billion tons. Of this, about 300 million tons have been mined, or only a fraction of 1 percent. And that gives you the coal reserves of Utah and Wyoming, and the oil-shale reserves of Utah.

Senator MURDOCK. Does that conclude your statement, Mr. Dyer?

Mr. DYER. That is all.

Senator MURDOCK. Any questions? Senator O'Mahoney, do you have any questions?

Senator O'MAHONEY. No.

Senator MURDOCK. Senator Gurney?

Senator GURNEY. No questions.

Senator MURDOCK. The next witness is Mr. F. C. Merriell, of Grand Junction, Colo.

STATEMENT OF F. C. MERRIELL, CHIEF ENGINEER, COLORADO RIVER WATER CONSERVATION DISTRICT, AND REPRESENTATIVE OF THE CHAMBER OF COMMERCE, GRAND JUNCTION, COLO.

Mr. MERRILL. I have a map, Mr. Chairman, which I will unroll.

Senator MURDOCK. All right.

Mr. MERRIELL. Mr. Chairman, members of the committee, and Congressmen, my name is F. C. Merriell, from Grand Junction, Colo., and I represent the Grand Junction Chamber of Commerce. My occupation is chief engineer of the Colorado River Water Conservation District. I will have occasion to refer to water and my regular occupation during the presentation.

In preparation for this hearing, it was not certain that there would be available information regarding the actual territory involved. I realize the testimony that Mr. Dyer and I have to present represents a very distinct anticlimax from the interesting presentations that were made this morning, but perhaps for awhile we can get our feet on the ground while we discuss the actual physical resources which are involved.

The map which has been prepared in our office represents all three States—the States of Wyoming, Utah, and Colorado. The information shown on the map as to Utah is exactly the same, so far as the confines of the map permit, as is shown upon Mr. Dyer's map, and then the representations are extended to the other States. If I may, Mr. Chairman, I would like to work at the map.

Senator MURDOCK. That will be all right.

Mr. MERRIELL. Upon the map are shown the outlines of the shale deposits in the three States; they are these areas which are enclosed in red. There are also shown the coal outcrops as they exist in Utah, in Wyoming, and in Colorado. That is the first feature, perhaps, to which attention should be called; the fact that we show the coal outcrop, but, owing to the geological position of the shale measures, we can show the outline of the shale measures. The reason for that is, while they are all very recent geological formations, the coal measures are older than the oil-shale measures, and the oil shales lie above them and are exposed, in most cases, on all sides. So, while it is necessary to go underground for coal, it isn't essentially necessary to go underground for shale, because the shale is all, so to speak, above ground.

Now, there are shown on the map also the naval oil reserves which were set up in about 1919; reserve No. 1 in Colorado, which lies within the outcrop of the shale; reserve No. 2 in Utah which also lies within the outcrop; and reserve No. 3, which is outside of the outcrop of the shale in Colorado. As you can readily see, we in Colorado, like the people in Utah, have both resources present and largely in the same area.

It is unfortunate this map does not show the railway, although the Denver & Rio Grande Western Railway, as probably most of the audience knows, comes down the Colorado River to Grand Junction,

then across the desert, then up the Price River, and over the Wasatch Range and into Salt Lake City. The Moffat road—the Denver & Salt Lake Railway—ends at Craig on the Yampa River. And the Union Pacific Railway crosses Wyoming in a way with which most of you, I suppose, are more familiar than I.

In addition to pointing out that the oil-shale measures are readily accessible from all sides, it is desirable also to point out that in Utah and in Colorado they are especially accessible to two things—to transportation and to water. And for just a minute or two, I am going to discuss water. Among the objections that have been raised to the utilization of shale, there are two which are perhaps regarded as the most important. One is the question of water, and those of the audience who were present yesterday at the Geneva Steel Works when Mr. Barber, of that works, explained his project to the assembled group will remember the first question Mr. Barber settled was the question of water; before he began to describe what the steel works would do, he pointed out to those there that the steel works wouldn't be a burden upon the water of the community. And in the same way, it is true that we have here in Colorado the Colorado River, which is the largest stream in the State and the largest stream in Utah when it gets into Utah, which is readily accessible to the shale fields.

Now, for a personal observation: My business deals with the Colorado River—my regular occupation; it consists in seeing that our people develop their water resources to the greatest possible extent, and that those water resources should be protected in every way possible. We have consistently, for a number of years, attempted to study every estimate which has been made by people studying oil shales as to the use of water in the processing. Those uses which have been set up in these various reports are necessarily and properly in two divisions, the uses of the oil-shale plant itself, and the uses of the domestic settlements which must necessarily go with the plants. Our conclusions are, first, that domestic use has been greatly overstressed; we find that our own cities, which are comparable users, get along with much less water than these people have allowed for domestic use. As to the plant use, the same thing applies there, which Mr. Barber mentioned yesterday. He has circulating through his plant a tremendous quantity of water, but he indicated that only a very small quantity of water is actually consumed. And, so far as all previous estimates we have been able to get hold of are concerned, it is the same situation there. It will be a tremendous circulating use, but the consumptive use of water is going to be very small. Therefore, we believe that we can offer a very considerable quantity of water for such development, because in the Grand Valley (which is one of the largest agricultural areas in western Colorado), we have developed and are protecting a very large use of water, which can be used for circulating purposes. One of the first actions of this district was finding a reservoir on the upper Colorado River and a canal leading along the shale measures by which the reservoir water could be made available for the shale uses. So we feel we have to offer, first, transportation, and second, water.

As to the question of dump space for the spent shale, we have no feeling that that will offer any difficulty; we believe that can be disposed of very readily.

The areas in Utah, Wyoming, and Colorado, according to Bulletin No. 415 of the Bureau of Mines, contain the following quantities of oil: In Utah, 48,800,000,000 barrels; in Wyoming, 3,044,000,000 barrels; and in Colorado, 79,625,000,000 barrels. The bulletin which contains this estimate says that 60 percent of its oil content is recoverable. The figures in that case become: For Utah, 25,680,000,000 barrels of oil; for Wyoming, 1,826,000,000 barrels of oil; and for Colorado, 47,625,000,000. So that out of a total of 125,500,000,000 barrels of oil at present in the shale, it is assumed that 75,500,000,000 barrels are recoverable.

Now, there are shales in other parts of the United States, but this body of oil shale shown on the map contains 87 percent of all the oil shales present in the United States, and, according to the figures of this bulletin, 82 percent of all the shale oil recoverable from the whole United States.

Since coal is a material which can be subjected to the same processes and produce the same products, we have shown upon the map the outcrops of the coal measures in Colorado which come within the limits of the map. Please understand that there are a great many other coal measures in Colorado beyond the confines of this map. The estimates for these three fields shown here are as follows: I am sorry to say I don't have an estimate of the tonnage from the Colorado River east in the Garfield-Grand Mesa field, but the estimate from the Colorado River west to the Utah line is 4,207,000,000 tons of coal; in the Meeker field, or White River field, in the Meeker quadrangle, the estimate is 10,645,000,000 tons of coal; in the Axial field, in the Yampa and White River Basin, approximately 20,000,000,000 tons of coal. And I offer these figures for the record.

Senator MURDOCK. They will be received, and printed at this point in the record.

Estimate of total and recoverable oil in oil shale

[Bureau of Mines, Bulletin No. 415. Unit—Barrels of 42 United States gallons]

State	Total oil	Recoverable oil
Colorado.....	79,625,990,000	47,625,598,000
Utah.....	48,800,000,000	25,680,000,000
Wyoming.....	3,044,000,000	1,826,400,000
Total.....	125,469,990,000	75,332,098,000

The foregoing totals are respectively 87 percent of the total oil content, and 82 percent of the recoverable oil content of all known oil shales of Tertiary or Devonian age, and of all cannell coals in the United States.

Estimated tonnage, Colorado coal fields

[U. S. Geological Survey Bulletins 851, 812C, 757]

	<i>Tons of 2,000 pounds</i>
Book Cliff coal field, Utah State line to Palisade, Colo.....	4,207,500,000
Meeker quadrangle coal field.....	10,645,000,000
Axial and Monument Butte coal fields.....	20,000,000,000

The coal fields for which the tonnage is shown are in the same territory as the oil shale in western Colorado. They are by no means the only or the largest coal fields in the State.

STATEMENT OF THE GRAND JUNCTION (COLO.) CHAMBER OF
COMMERCE, SUBMITTED BY F. C. MERRIELL

Mr. MERRIELL. It would be very unbecoming for anyone who is merely talking about the political resources of the region to offer very much in the way of a statement about the process or technique. It reminds me of a hearing of the Colorado River Commission 21 years ago, in which we finally persuaded them to hold one meeting in Grand Junction because they ought to hold a meeting on the river. As you travel along the highway or the railway, the Book Cliffs look like gray monotonous cliffs which follow the railway for scores of miles, and probably as you have traveled along you haven't realized that if these cliffs were broken open to a fresh surface that what you would see, instead of that dead gray, would be a very beautiful black. That is a sample of the mahogany or rich shale. This is a sample of oil that was gotten from about that same shale. Here are other samples of these shales. If we had time, we could hold a match to these samples and show that they burn, and when they burned you would realize immediately that what was burning was oil.

In the presence of all the experts on the matter, I am not going to attempt to define what oil shale consists of, beyond saying that under certain conditions it might have been coal; and if it had been carried a little further so all this carbonaceous matter was distilled underground, it might have been oil. Here, it is just raw material, a potential source out of which almost anything of hydrocarbon nature may be made. The Bureau of Mines reports that since 1929 not too much has been done. Dr. Coolbaugh, I understand, ceased his active interest in shale about that time. My own experience with shale ended 20 years ago. Research made possible by private money has been carried on the last 15 years. It would be too bad if research such as this were not made available for the development itself; not only all the information possessed by the Federal agencies and all the information possessed by the various State agencies, but also the real research which has been done by oil companies and by private individuals, which should all be pooled in this development. There is, in the war emergency, very adequate warrant for that statement. People who, one week in January 1942, were competitive automobile manufacturers, the next week were cooperating manufacturers of munitions. Airplane manufacturers, who still regard themselves as competitors and hope to become actively so after the war, are now pooling all the knowledge they have for the common product of victory.

I hope that when this thing becomes workable, following the passage of your bill, Senator, that that is what will happen, and all the people who know anything about hydrogenation of coal and the processing of shale will join together to give us fuel, not only for war purposes, but for the peace as well after the war. And I suspect we will need it greatly after the war.

Senator MURDOCK. Are there any questions? Congressman Randolph?

Congressman RANDOLPH. Senator Murdock, I wonder if President Coolbaugh is in the room. I would like to ask a joint question of him and the present witness, because I believe they touched on a subject on which I would like to get their viewpoints. I will ask the wit-

ness, because he referred to it somewhat in his final sentence. You speak of the downward curve, or that was probably the language of Dr. Coolbaugh, of our petroleum production as we find it under the demands of war; and I believe you yourself mentioned that perhaps the greatest need for petroleum would be in the peace to come. We will be faced with a continuing downward curve in peace time, just as in war time; is that correct?

Mr. MERRIEL. Yes.

Congressman RANDOLPH. Provided we do not find new sources?

Mr. MERRIEL. Yes. I think Dr. Coolbaugh went on to say that while we can say there is certain petroleum reserves in the ground, we must all realize we cannot merely extract that whenever and to whatever extent we please; we can only draw upon that rather slowly in the regular process of production, so that we may face a greater shortage than that reserve of petroleum would tend to indicate, increasing from now on, whether at war or peace.

Senator MURDOCK. Senator Gurney?

Senator GURNEY. No questions.

Senator MURDOCK. Are there any other questions? Thank you very much, Mr. Merriell. I might state for the benefit of the audience that Senator Gurney, of South Dakota, actually demonstrated here to all of us that this shale would burn. The next witness is Mr. L. C. Karrick.

STATEMENTS OF L. C. KARRICK, SALT LAKE CITY, UTAH, FORMER COAL AND OIL INVESTIGATOR OF THE BUREAU OF MINES AND GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

Mr. KARRICK. I was formerly connected with the United States Bureau of Mines and the United States Geological Survey throughout the first 7½ years of the Government's work on oil shales and the production of oil from coals of the public lands.

Senator MURDOCK. You are now residing here in Salt Lake City?

Mr. KARRICK. I am residing in Salt Lake City. Following my resignation from the Bureau of Mines, I returned to Utah and for 8 years was Director of Research at the University of Utah.

THE FEASIBILITY OF A COAL-OIL AND A SHALE-OIL INDUSTRY IN THE ROCKY MOUNTAIN AREA

By December 1926 my coworkers and I in the Federal Government's employ had completed over 7 years of chemical and engineering studies of coal, oil shales, and oil sands of the United States and foreign countries, and we were satisfied that oil could be made profitably from the coals of the Rocky Mountains, Mesa Verde formation, for less than \$1 per barrel with large profits, also that oil could be made from the oil shales and oil sands of this area, by processes investigated, for about \$2 per barrel, with no credit for byproducts made from the spent shale. Some of us also were satisfied that by applying the thermochemical principles that we had worked out to large masses of oil shales or coals in underground stopes or chambers that oil could be manufactured profitably for about 75 cents per barrel. The subsequent work of students which I have

directed at the University of Utah during 1930 to 1938, in the mechanical, civil, chemical, and economics departments, has furnished further proof that these new vast oil industries are commercially feasible and timely. The latter investigations are in the form of bachelor of science and master of science theses of students who have been granted degrees in the above-named departments of the University of Utah.

In order to fortify your congressional fact-finding committee, I wish to state that there are eight of these reports filed in the engineering library of the University of Utah and are available for inspection by your body or your representatives. Also, there are eight printed reports of investigations of the United States Bureau of Mines in cooperation with the States of Utah and Colorado on the oil shale and coal studies of the Rocky Mountains. Then there are five printed reports of studies made at the Pittsburgh station of the United States Bureau of Mines on the oils and gases produced from Utah coals by the semicommercial size plant that I built and operated in 1924 to 1926 while employed by the United States Bureau of Mines and Geological Survey and while holding a fellowship at Carnegie Institute of Technology. In all of these studies I have been connected as a researcher, a director of researches, or a consultant. And finally, there are 14 issued United States patents covering the technology worked out in our long researches and describing methods that we thought would be most practicable in using these data most pertinent to treating of our western coals, oil shales, and oil sands. One of the patents is issued jointly in the names of my coworker in the Government's employ and myself. The data embraced in the foregoing technical publications are very extensive, and clearly present bases for a present successful industry, making very low-cost oil from coals of the West. I am now ready to answer questions and supply proofs for the above statements. I desire that the Federal Government take over and administer the uses of the research data and the present and future patents issued to me, and the United States Attorney General is so advised.

WESTERN COAL OPERATORS

If Secretary Ickes' plan becomes a reality and he uses Government funds for the establishment of an industry to hydrogenate coal so as to produce oil for the future of the Nation, then the western coal-mining operators should have protected themselves by bringing forcibly to the attention of Washington some important facts. Bearing in mind that it has been shown by Bonner,¹ Karrick,² Horne,³ Standing and Zimmerman,⁴ Storch,⁵ and other State and Government chemists that Utah's remarkable coals yield much more oil than any other large body of bituminous coal in the United States, by both distilla-

¹ Bonner, W. D., and Johnson, B. J., Coal versus Oil Shale as Source of Motor Fuel: Mining and Contracting Review; November 15, 1922.

² Karrick, L. C., Manual of Testing Methods for Oil Shale and Shale Oil: Bull. 249, U. S. Bureau of Mines, 1926, 70 pp. Karrick, L. C., a Convenient and Reliable Retort for Assaying Oil Shale for Oil Yield: U. S. Bureau of Mines, Reports of Investigations, Serial No. 2229, 1921; revised April 1922.

³ Horne, J. W., and Baner, A. D., Comparison of Oils Derived From Coal and From Oil Shale: U. S. Bureau of Mines, Reports of Investigations, Serial No. 2832, October 1927.

⁴ Standing, Marshall, and Zimmerman, Edwin, An Analytical Survey of Utah Coals: Chemical Engineering Thesis, University of Utah, May 26, 1936.

⁵ Storch, H. H., Hydrogenation: Chapter in Research and Progress in the Utilization of Coal, pp. 45-49 in National Resources Planning Board, Technical Paper, 4, 1941, 49 pp.

tion and by hydrogenation—enough oil to supply the entire United States for over 200 years, then consider the following vital factors in working out their salvation:

(1) Utah's coal of the Mesa Verde formation will soon be processed on large scale for the production of motor fuels and other petroleum products, rich city gas, superior cokes, and smokeless fuels for domestic and industrial uses, chemicals for synthetic rubbers, plastics, and fertilizers. All of the oil of the United States was manufactured from coal prior to 1859; it is not new. Now it is recognized as an economic crime to burn coal in the raw state.

(2) The oil and chemical industries are not going to wait for present Utah coal operators to build their own coal-processing plants, their first move already having been the bringing in of natural gas from outside Utah. This secured for them a monopoly, through the gas franchises given them, of all markets for the byproduct gas which will be obtained when oil is distilled from the coals in the process of making smokeless fuels, coke, and oils.

(3) When coal is mined for the manufacture of oil products, city and industrial gas, domestic smokeless fuels and cokes, chemicals and electric power, the favored mines will operate 12 months every year and with greater economies.

(4) The above coal products can be shipped in the form of coal much more cheaply than as finished products. The new industry will create greater markets for Utah coal and assure greater return of money into the State of Utah. Utah coal, a valuable basic chemical, should be shipped throughout the West to centers of industry and population, and then be converted into its many valuable products and sold through the usual retail channels.

(5) Utah coals are relatively easy to convert into crude oil, rich gas, and smokeless domestic and industrial fuels, and the investment and conversion costs will be low. The "authorities," who have made it their business to obstruct this new Rocky Mountain industry, have cited many failures in the East as conclusive proof that our industry will not be economically feasible. The Utah coal operators should keep in mind that most eastern bituminous coals melt when they are carbonized, which is accompanied by swelling and adhesion to the retort or over walls, causing serious mechanical troubles, poor products, and high costs. Other eastern coals of the lignite and subbituminous ranks fall into dust or fine particles when carbonized in ovens or retorts, requiring costly briquetting of the product which again makes it smoky, and giving a poor yield and quality of oil and gas. Utah coals were proved at an early date (1) to have remarkable chemical and physical properties. This coal can, therefore, be screened into the sizes desired for the final products of coke and domestic smokeless fuels and then carbonized without any sticking troubles, and they will retain their lump forms when processed by methods worked out in the Federal Government's studies. Thus, the product is in final form by one simple low-cost treatment, with simultaneous production of very high-quality gas, and a crude oil which is easily refined into motor fuels of high antiknock value, Diesel oil, and other petroleum products as well as important chemicals which are critical war materials. The investigators of the Government also demonstrated that this coal becomes plastic within a certain temperature range and can

be compressed while undergoing carbonization and produce blocks of smokeless fuel in any desired hardness, size, or shapes.

(6) The smokeless fuel obtained by applying the technology worked out in the Government's studies is an excellent solid motor fuel, suitable for use in all gasoline-burning engines in passenger cars, busses, farm tractors and trucks, or small farm power plants for community or individual uses. In a half-dozen foreign countries this type fuel in briqueted form, or charcoal, is used in a great number of the above vehicles and power units, the solid fuel being converted into gaseous engine fuel with small, attached gas generators. Further studies made at the Utah School of Mines and Engineering in recent years have also proved this sized lump smokeless fuel to have the properties of an excellent solid fuel for use in place of gasoline. Considering the efficiencies of the two motor fuels—gasoline gasified through a carburetor, and the new solid motor fuel gasified through a generator, also combustion efficiencies—it is safe to say that this new motor fuel can be made available throughout the State at less cost than gasoline for engine power. Thus the oil-from-coal industry need not be limited in size, as some authorities have said, by the relatively small market for the smokeless fuel in residence, industry, railroad, and metallurgical uses. This solid motor fuel market will quickly grow and may dominate the civilian motor-fuel market, leaving gasoline for war uses where very high antiknock motor gasoline is vital in holding air superiority.

(7) The data obtained in the Federal Government's coal-distillation researches on the Mesa Verde coals are safely stored away and many patents have been issued to these engineers' processes which were developed and tested for making commercial use of the new information, all for the sake of protecting a large coal-products industry. These data and developments are offered to any Federal Government holding company to be formed, or research organization, for licensing to present Utah coal companies, new companies, or public service organizations, who will pay royalties to support coal research fellowships at the Utah and other universities, and to finance trade and vocational courses in schools that will be established for labor and farmers in their centers of industry. This new coal-products industry was made possible through the expenditure of hundreds of thousands of dollars of public tax money.

(8) Below appears a summary of results obtained by Federal Government and State of Utah researchers from studies of the yields of oil, smokeless fuels and gas from the distillation of 60 coals of different ranks in the Rocky Mountain area. The data indicate that the yield of oil from the coal of certain mines in Utah is much greater than from other nearby mines producing the same rank of coal. It will, however, prove to be the case that all mines will average about the same and each will vary between 30 and 44 gallons of oil per ton of coal. This can be expected due to the fact that these coals owe their origin to the same general types of vegetation, and no major differences in geophysical and chemical actions could have taken place between different parts of the great coal measure where the mines are now operating. The variation of yield of oil within the same mine is probably accounted for in differences in concentration of the waxy parts of vegetation. Much of the vegetable matter in the Mesa Verde coals came

from conifer trees and evidences of this have long been known by the content of the visible natural resins in the Utah coals which are so plentiful and yet vary widely in different mines and in different parts of the same seams. The oil, gas, and smokeless fuels determinations presented below were made by the assay method developed in the United States Bureau of Mines studies,² and the data largely obtained by the aforementioned investigators.^{1 2 3 4} Some came from recent studies by the writer, much of which data has been given to the United States Department of Agriculture and to other Government agencies.

Crude oil, smokeless fuel, gas from coals of the Rocky Mountains

[Yields per ton of coal, on as-received basis]

State and county	Mine	Crude oil (gallons)	Smokeless fuel (pounds)	Gas	
				Cubic feet	British thermal units
Utah:					
Carbon.....	Blue Blaze.....	43.1	1,340	1,677	930
Do.....	Aberdeen.....	33.5	1,460	1,495	967
Do.....	Kenilworth.....	33.5	1,748	1,748	965
Do.....	Lion No. 1.....	31.9	1,333	2,236	896
Do.....	Lion No. 2.....	32.7	1,373	1,443	971
Do.....	Maclean.....	40.7	1,352	1,528	956
Do.....	Sweet.....	36.7	1,348	2,021	961
Do.....	U. S. King No. 1.....	35.9	1,348	1,792	941
Do.....	U. S. King No. 2.....	39.1	1,367	1,641	1,022
Do.....	Chesterfield.....	36.6	1,448	1,641	943
Do.....	Synnsyside.....	35.2	1,436	-----	-----
Columbia.....	Columbia.....	36.8	1,414	-----	-----
Do.....	Horse Canyon.....	37.6	1,400	-----	-----
Do.....	Standard.....	33.0	1,370	-----	-----
Emery.....	Huntington Canyon.....	38.5	1,277	-----	-----
Do.....	Sevier Valley.....	32.8	1,231	-----	-----
Do.....	Willow Spring.....	36.7	1,322	-----	-----
Summit.....	Weber.....	24.0	1,130	3,350	800
Do.....	Grass Creek.....	24.0	1,105	3,100	805
Iron.....	Coal Creek.....	18.0	1,100	-----	-----
Kane.....	Meeks-Carrol.....	18.0	1,100	-----	-----
Kane.....	Cannel-King.....	65.0-80.0	1,140	-----	-----
Duchesne.....	Red Creek.....	21.7	1,322	-----	-----
Colorado:					
Mesa.....	Pallisade (1).....	28.2	1,390	-----	-----
Do.....	Pallisade (2).....	26.4	1,260	-----	-----
Delta.....	Cedaredge GV.....	25.0	1,240	-----	-----
Do.....	Juanite, Bowie.....	33.8	1,530	-----	-----
Gunnison.....	Crested Butte (1).....	28.5	1,220	-----	-----
Do.....	Crested Butte (2).....	25.2	1,374	-----	-----
Do.....	Crested Butte (3).....	35.0	1,426	-----	-----
Do.....	do.....	29.6	1,350	-----	-----
Do.....	Crested Butte (4).....	34.5	1,300	-----	-----
Montezuma.....	Mesa Verde.....	31.0	1,170	-----	-----
La Platt.....	Henderson.....	32.2	1,336	2,805	906
Huerfano.....	Alamo Coal Co.....	22.1	1,428	1,980	798
Elbert.....	Wright Mine.....	8.6	936	4,135	542
Weld.....	National Fuel.....	10.1	1,038	2,780	547
Moffatt.....	Richards Mine.....	11.4	1,154	2,790	516
New Mexico: McKinley.....	Navajo.....	27.8	1,182	1,180	739
North Dakota.....	Average of 6 mines.....	6.0	830	3,548	449
Wyoming:					
Carbon.....	Union Pacific No. 4.....	19.4	1,032	3,542	750
Campbell.....	Kirby Mutual.....	12.5	1,014	2,000	450
Sheridan.....	Hotehkiss.....	12.4	1,000	3,503	585
Fremont.....	Proposia No. 1.....	12.1	1,172	895	788
Lincoln.....	Kemmerer Ekkol.....	17.0	1,136	1,970	798
Do.....	Kemmerer Susie.....	24.2	1,420	2,700	951
Sweetwater.....	U. P. Mine No. 8.....	24.0	1,372	-----	-----
Do.....	Gunn-Quealy.....	28.0	1,366	-----	-----
Idaho:					
Teton.....	Black Diamond.....	33.8	1,475	-----	-----
Do.....	Cottonwood.....	27.8	1,370	-----	-----
Montana Rosebud.....	Colstrip.....	8.8	1,044	2,400	593

See footnotes on p. 335.

In the discussions of the hydrogenation of coals of the United States it has been stated by Storch⁵ and others that the small scale (6 pounds per hour) hydrogenation plant of the Bureau of Mines at Pittsburgh gave results proving that one coal from Carbon County, Utah, was converted 75 percent into oil (on moisture and ash free basis); the next highest in the United States was an Illinois coal which yielded 70 percent oil, while other high-grade bituminous coals yielded slightly less oil. However, it was shown that all coals, regardless of rank, give about the same percentage conversion into oil when figured on their ash and moisture free analyses. Consequently the low-rank coals will give much less total oil, but they must meet the same mining, preparation, and manufacturing costs with possibly some reduction in hydrogen used per ton of coal. The direct hydrogenation process operates at 3,300 to 4,500 pounds per square inch pressure. Considering the high investment cost of such high-pressure plants, the high cost of the hydrogen gas, the new developments needed and training of operating specialists, it is estimated that gasoline can be made for 18 cents per gallon, possibly 12 cents ultimately, or twice the cost of petroleum gasoline at the refineries of the United States.

If our rich Mesa Verde coals are distilled for oil and, as seems reasonable, they experience the same mining and manufacturing cost as stated by Government experts, before the hearings of the Senate Public Lands Committee on October 6, 1942, for the mining and treating of oil shales of same richness, then both will produce oil for \$2 per barrel. Now, if the smokeless fuel is sold at the mine processing plants at the same prices as set by the Bituminous Coal Commission for bituminous coals, then from the above table of yields of products it can be calculated that the revenue from the smokeless fuel is more than the entire cost of the crude oil made from Utah coal.

As Secretary Harold Ickes once asked in the Saturday Evening Post, "After the oil deluge, what price gasoline?", the western coal mine operator can reply, "At less than the price before the wasteful oil deluge, provided that more scientists and fewer politicians are permitted to conserve this greatest national resource."

Senator MURDOCK. As I remember your testimony at the hearing in 1941, Mr. KARRICK, you mentioned the figure of 70 gallons.

Mr. KARRICK. Yes, sir.

Senator MURDOCK. Also, as I recall it was the maximum extraction from Utah coal. Our hearings have developed the maximum runs up as high as 136 gallons from Utah coal. I don't understand the discrepancy. Could you explain that?

Mr. KARRICK. Yes. All the figures mentioned are correct, but they belong to answers to different questions. For instance, I mentioned then 70 gallons of oil per ton on the yield of oil from cannel coal near Zion National Park. I happened to be assigned to research work in that year. That coal yields from 65 to above 80 gallons per ton—that's crude oil. We have done a great deal of refining work on that; and the Union Oil 4 years ago did some work on it. Now,

⁵ Storch, H. H., Hydrogenation: Chapter in Research and Progress in the Utilization of Coal, pp. 45-49 in National Resources Planning Board Technical Paper 4, 1941, 49 pp.

the 136-gallon figure is the amount of gasoline that would be obtained by hydrogenation, as Dr. Fieldner brought out, and Mr. Kraemer.

Senator MURDOCK. Is it not just a question of the process applied as to the quantity of oil obtained; would that account for the discrepancy between the 70-gallon figure and the 136-gallon figure?

Mr. KARRICK. Yes, sir.

Senator MURDOCK. At this time I wish to call attention to the fact that our time is rapidly going by, and where you have a paper prepared, if you will try to highlight it and give us the pertinent parts of it, and then submit the whole paper for the record a great deal of time will be saved. If we don't do that, there will be a number of witnesses we cannot hear. As I understand it, you have submitted the paper?

Mr. KARRICK. I have submitted it for your record. And here is a photograph of cars running in England today with solid motor fuel in place of gasoline. Each of these cars was made to operate with gasoline. Here is a Fordson tractor, a farm truck, a passenger bus, and an automobile, operating not with charcoal but coal with the oil taken out, or low-temperature coke, as we call it.

Senator MURDOCK. Now, are there any questions?

Congressman RANDOLPH. Senator Murdock, I am intensely interested in what has been said about production of gasoline from western coals and oil shales. Of course, this committee is interested in the Nation as a whole. I certainly commend the western witnesses in behalf of their own territory, certainly, but I think we must during the hearing call attention to the fact that the production of gasoline from the bituminous coals of my own State of West Virginia, and other eastern sections, will be in comparable yield of gasoline to the best coals in the West; is that not true?

Mr. KARRICK. According to Dr. Storch and, I believe, Dr. Schroeder, of the Bureau of Mines, one of the Utah coals yielded 75 percent; the next best coal, according to present published data, was an Indiana coal that yielded 70 percent; others were close to that. This yield is a little more than any other in the United States, and possibly West Virginia is included in the 70 percent.

Congressman RANDOLPH. Is it not a fact that the bituminous coals in the western area and in the eastern area are practically comparable in the gallons of gasoline produced from a ton of coal?

Mr. KARRICK. There isn't much difference, but it is in favor of the western coals. [Applause.] Really, the western coals are better, according to Bureau of Mines standards. Drs. Storch and Schroeder showed that.

Congressman RANDOLPH. I want to say, not facetiously but very earnestly that this picture will develop from the standpoint of the entire United States; and we of West Virginia will certainly be active in behalf of our State just as you in the West will be active in behalf of yours.

Senator MURDOCK. We will now hear from Mrs. Anthony C. Lund, president of the Women's Chamber of Commerce, Salt Lake City.

STATEMENT SUBMITTED BY MRS. ANTHONY C. LUND, PRESIDENT,
WOMEN'S CHAMBER OF COMMERCE, SALT LAKE CITY, UTAH

Mrs. Lund, may I call your attention, with all due respect, to the fact that where you have a written statement, if you can summarize it as much as possible, then submit the written statement for the record, we will appreciate it.

Mrs. LUND. Senator Murdock, honorable Congressmen, and ladies and gentlemen, I want to express appreciation to Congressman Randolph for the welcome extended the ladies today. We are vitally interested in this subject. I want to say, I am Mrs. Anthony C. Lund, president of the Salt Lake Women's Chamber of Commerce. I might say, we are a crusading, educational organization; I think that will analyze our work. We have a membership of 5,000 charter members; we are unselfish in our purpose, there will be absolutely no personal gain so far as we understand it.

For the past 10 years, the members of the Salt Lake Women's Chamber of Commerce have been seriously researching for the facts and figures that deal with the causes and effects of the smoke menace in Utah. We have investigated many processes and have sent tests to many processing plants. We have visited plants in Oregon, North Dakota, Canada, England, Germany, and China. We have had engineers here for consultation from Canada, England, Germany, China, New York City, Minneapolis, Omaha, Colorado, Oregon, and California.

1. We have learned that in every case, processing plants now in existence are there because of the need to conserve the byproducts of coal. From these researches, smokeless coal has been found.

These are just the highlights of what we actually have. By invitation of Mr. A. S. Brown, I made 14 brief statements as to what we have tried to accomplish. And then I want to say that if there is anything we have in the way of the evidence I refer to, that we are very happy to pass that to you for the regular records. I will be just as brief as possible.

2. We have learned that millions of dollars have been spent in tests and researches by the city, the State, and the Nation, and by private individuals and companies, and that these researches have been duplicated over and over until great sums of money have been spent. We have proved that we have known since 1924 just what must be done if the people of Utah are to be assured any degree of security, health, and welfare, because of the waste of our natural wealth of resource and the destructive elements of the smoke that comes from the burning of raw coal.

3. In answer to the challenge from businessmen, coal producers, and citizens who should be vitally concerned with the possible progress and development in coal processing when they said, "Oh, well, that is just laboratory tests, that does not mean that it will be successful if done one a big scale," the Women's Chamber of Commerce sent 40 tons of coal to Frankfurt A. Main, Germany, to get all the scientific information possible on a big-scale test. This was in 1939, and at the same time Congress was telling us we would never become involved. We sent it to a plant that was successfully operating. The cost of sending the coal was \$1,850, and the preparation of the coal.

4. This coal was sent in April 1939 and was packed in 219 steel barrels, sealed and labeled to keep separate the 8 types of coal, taken from 4 different coal mines in Utah, and the official test took place during the period July 5-16, 1939.

The steel barrels were labeled 1-a, 1-b, 2-a, 2-b, and so forth, according to the number of barrels needed to carry 5 tons of nut coal and 5 tons of stove coal from each of the 4 coal mines. Each barrel was weighed and the net weight and gross weight was listed. The name of the coal or the mine from which the coal was taken was not disclosed to the company making the test. And the detailed report of the poundage, and the barrels, and the name of the coal, are available to you if you desire to have them.

5. The report shows how Utah coal acts in a continuous run of coal, ton by ton, and hour by hour. The analysis of all 4 coals gives the percentage of tar, water, ash, and volatile matter in each.

6. Mr. M. Douglas Wood, of Salt Lake City, then president of the West German Mission for the Latterday Saints Church, and Mr. Richard Barnes, his secretary, were the official witnesses of the Women's Chamber of Commerce, and were present while the commercial test was being made. Mr. Wood is present at this hearing. I would be very happy to have you let him be presented when I am through.

7. The scientific test on the 40 tons of coal proved that Utah coal is 5 times as valuable in coal tar as any of the European coals tested, and that Utah coals are notable for their low content of impurities, and have excellent physical qualities. This corresponds with our contention that Utah coal contains 35 times the largest present commercial supply of crude oil of any State in the Union, because we have better coals for processing and a greater demand for gaseous and solid smokeless fuels. We want to remind you that there is also a great value in the residue of coal, perhaps much more than would come from oil shale.

8. The summary of the report says:

All 4 coal types are well suited for the Lurgi carbonization process. There are no objections to treat this coal in a large commercial plant. The coke derived from these tests is very good quality, hard, and of fairly large lumps, a sign that it hardly falls apart. Furthermore, the coke ignites quickly and burns completely smokeless.

9. The measurements necessary for the proper operating control were made hourly during the test. After the required conditions were reached, the through output and the yield were determined and the following measurements made: (1) Quantity of coal charged; (2) quantity of coke derived; (3) quantities of tar and oil recovered at the following places: (a) At precooler, (b) at Cottrell precipitation, (c) at the surface coolers and impact separator; (4) benzine content of the pure gas by means of activated carbon. (The necessary gas was taken behind the impact separator.)

10. During the tests average samples were taken and analyzed in the laboratory. The carbonization analysis was made in the aluminum retort according to Fischer-Hampel, and the proximate analysis in the platinum crucible.

The analysis gave the content of each coal type as to tar, moisture, condensate, coke, gas, and residue.

The proximate analysis gave the content of each coal as to moisture, ash, fixed carbon, volatile matter,

The tar analysis showed tar, precooled; Cottrell tar, and middle oil.

11. We have pictures of Mr. Wood and Mr. Barnes witnessing the commercial test. We also have engineering plans and estimates for the building of a 250-ton-a-day plant based upon the result and action of the 40-ton test, giving estimated cost of equipment, supplied and installed, and the personnel necessary for such a plant.

12. The report gives a sketch of the testing plant which indicates the points where measurements for temperatures, pressure, and quantities of gas were made. Detailed reports of scientific tests made on Wyoming coal, and plans for a proposed plant are also in our possession, any and all of which we are happy to submit to this committee.

13. The outstanding recommendations for the processing of Utah coals are that it is adaptable to all kinds of coals, low-grade coals that are unmarketable slacking coal may be blended with higher grade coking coal, thereby affording a market for an otherwise unsalable product.

This solid smokeless fuel is adaptable to the hand- or stoker-firing methods. It can stand considerable handling. It can be stored under a wide range of conditions with no danger of spontaneous combustion.

It is easily ignited and is slow-burning. The release of heat over a much longer period of combustion insures the application of this heat to the point of greatest utilization, insuring a much greater heating efficiency per pound of processed coal than could be accomplished in the use of raw coal.

Needless to say, there is a great demand for this smokeless coal in the industries.

14. Every resource of statesmanship and good government must be brought to bear to force the adoption of solid smokeless fuel, now offered through science.

Unselfishness and determination can solve our problem. Business sagacity, foresight, prompts the use of a small part of the enormous sums that annually go up in smoke to build processing plants in Utah's various valuable coal fields, to provide an abundance of solid smokeless fuel, and fill the State with the cleanest cities in the world. The refining of the byproducts will create industries and our population will increase, those who have left us in disgust because of the dirt and smoke will gladly return. Then in the wake of increased population, manufacturing plants will spring up, and the youth of this State will participate in the building of this great empire.

I thank you. [Applause.]

Senator O'MAHONEY. May I compliment Mrs. Lund and the Women's Chamber of Commerce for the interest they have displayed in having this very remarkable piece of work done. I think it speaks most highly for your understanding of the problems of the present and of the future. There can be no doubt that an enlightened public opinion, such as is represented in your presentation here this afternoon, would immediately relieve the cities of the country of the smoke nuisance. I think some of them referred to it as the smoke nuisance, which comes from the burning of coal which has not been prepared by the process for the removal of the elements that make the smoke. I

think the committee is very much indebted to the Women's Chamber of Commerce of Salt Lake City.

Senator MURDOCK. I am sure that is the unanimous opinion of the committee, Senator O'Mahoney and Mrs. Lund. I think the record may show that your organization endorses the O'Mahoney bill.

Senator O'MAHONEY. Thank you so much.

Mrs. LUND. May I present Mr. Wood, in view of the fact that he was present when this commercial test was made?

Senator MURDOCK. We will hear from Mr. Wood, whatever he wants to present for the record.

Mrs. LUND. He has pictures of the tests there.

Senator MURDOCK. Whatever you want to submit for the record, we will be glad to have.

STATEMENT OF M. DOUGLAS WOOD, OF SALT LAKE CITY, UTAH

Mr. WOOD. I was present in Germany at the time this test was made at the Lurgi Corporation plant. As Mrs. Lund stated, there were 40 tons of Utah coal shipped there and, as these pictures indicate, I was present at this analysis of the Lurgi Corporation. I am not a chemist or an engineer, but from the comments that have been made it brings back to mind some of the qualities of our Utah coal that were brought out there by the engineers who had this analysis in charge. Pictures numbered 7 and 8 will clearly indicate the burning of our Utah coal in the open bellows there at the Lurgi Corporation. The comment the engineers made were of this nature: That they thought it was a shame that such rich coal should be permitted to be burned in our fireplaces and furnaces over a city—that is, the smoke be permitted to hover over a city. In Germany with coal of this nature they would secure 21 or 22 byproducts that could be used commercially. Germany has been forced to do that because of the lack of the richness of their raw products, such as we have here. They have made tests from coal from South Africa, India, China, Greece, and all over the world, and they said there was no richer coal than that which came from our Utah coal fields.

I don't have much to elaborate on over that which Mrs. Lund has stated, only to say that because of the outbreak of the war the coal was not shipped back as finished products.

Senator MURDOCK. I would conclude from what you saw done with Utah coal that when Brigham Young said, "This is the place," he knew what he was talking about.

Mr. WOOD. Yes, sir. You understand, I took that scope beyond the United States. They said they knew of no better coal anywhere in the world.

Senator MURDOCK. Thank you, Mr. Wood. Is Mr. Bert Manley here? We would like to hear from him at this time.

Mr. MANLEY. Yes, sir.

Senator MURDOCK. State your name and your position or connection with the industry.

STATEMENT OF B. P. MANLEY, EXECUTIVE SECRETARY, UTAH
COAL OPERATORS ASSOCIATION, SALT LAKE CITY, UTAH

Mr. MANLEY. My name is B. P. Manley. I am secretary of the Utah Coal Operators Association, and I reside in Salt Lake City, Utah. I have the following comments to make on this bill with which the Senate committee is presently concerned.

I am executive secretary of the Utah Coal Operators Association, whose headquarters are in the Tribune Telegram Building, Salt Lake City, Utah. This association is the representative of Utah coal producers producing 98 percent of the commercial production of this State and represents producers in matters of general policy.

I desire to make a few comments with regard to S. 1243, in which this Senate subcommittee is presently concerned, the purpose of such bill being the authorization for construction of demonstration plants and their subsequent operation in the production of synthetic liquid fuels from coal and other substances.

The term "demonstration plant" would be taken to convey that such plant is for the purpose of proving, of showing by example and manifestation, that oils, synthetic or otherwise, can successfully and economically be produced from coal and other substances. If the purpose of S. 1243 is limited to the performance and demonstration of plants, this purpose is, in our opinion, a laudable one. There are great quantities of coal in Utah. It has been reckoned that 196,000,000,000 tons are contained in this State, spread over some 13,000 square miles. Generally speaking, the largest available producing areas are of high character, bituminous, and certain of these coals the Bureau of Mines have determined contain a probably higher oil yield per ton than could be obtained from any other coals in the Nation.

It follows that the coal producers of this State wish to produce and dispose of as great a quantity of coal as possible, and to supply all of the needs of the Western States to the limit of their physical producing capacity. If these coals contain oil of such quality and quantity as will build up the Nation's much needed oil supply, then investigation by way of experimentation and by demonstration plants should proceed, and to this extent we approve of the purposes of S. 1243.

But thereafter the feasibility of process or processes having been manifested by plant demonstration, the plans and processes should be made available to private enterprise.

The coal industry holds the Bureau of Mines in highest regard. It has through the years performed splendid service to the Nation and to every person engaged in the coal industry, and if given authority, will carry out the purposes of this bill insofar as experiment and demonstration is concerned, with the thoroughness and accuracy that such research warrants. The Bureau of Mines has always done a good job under all circumstances, and it is felt that it can do equally well in the determination of the feasibility of oil production from coal.

If and when it is demonstrated that oil can successfully be produced from coal, it, along with all other resultant products, should, in the public interest be marked through the usual and existing marketing channels, and not, as we read it as provided in section 2 of the

bill, wherein the Secretary of the Interior is authorized to sell the products at not more than actual costs and in certain instances at going prices. To this phase of the bill we offer our most serious objection and urge that this provision be stricken.

We fully agree with and believe that the determination of the full values of the Nation's natural resources is a worthwhile procedure on the part of the Government and should prove to be a great contribution to the public welfare, but after these determinations are made and research points the way toward successful and economical recovery of liquid fuels from these substances, then such results should be made available and turned over to such industry and private enterprise as are best equipped to proceed with production, refinement, and distribution. We believe that it is not the function of Government to engage in business nor to enter into competition with private enterprise.

The Utah coal industry will, I am sure, cooperate in every possible way to further experimental work, and limits its approval of this bill to such determination and manifestations, and reiterates its objections to and opposition of the entrance into the domain of private enterprise by any governmental agency.

Senator MURDOCK. What would you suggest be done with the products of such a plant?

Mr. MANLEY. Those products can be marketed through the usual channels of trade. For instance, oil could be placed through those who are producing and disposing of oil, and any other product or fuel through those who are handling fuels. Our thought is that the Government should not in any way, at any time, enter into competition with private business or private enterprise, and to this extent, gentlemen, we believe this bill goes too far.

Senator MURDOCK. I think that the author of the bill and the committee agree thoroughly with you, that there should be no competition.

Mr. MANLEY. The bill doesn't so indicate. Section 3, if I read it correctly, permits the Secretary of the Interior to dispose of this material and sell it to certain institutions at actual cost, and in other instances at going prices. I don't know how big you gentlemen might consider a demonstration plant to be, but as I understand it here today it would be of sufficient capacity to demonstrate it could be done, and not such as to supply the market. But the bill, as I read it, sir, does not so indicate. That's the only objection we have to this bill. This coal industry will extend its full and complete cooperation to the Bureau of Mines, and to all parts of it, as it expects us to do, and as we always have done.

Senator MURDOCK. Speaking for myself, it has been my thought that the products of such a plant, compared with the consumption throughout the entire United States, of competitive products, would be so negligible that it would not constitute competition of any kind; and that certainly no one would want the Government, after producing the products, to throw it away or waste it. I realize it is difficult, too, to write a provision of this kind that will satisfy everyone, but I am glad to have your comments on it.

Mr. MANLEY. Other industries that might be affected would see the entrance or a furtherance of Government in business. I don't believe any of you gentlemen on the committee want that.

Senator MURDOCK. Emphatically, I want to say, no, if I thought this bill would result in any such competition I wouldn't be for it for a minute.

Senator O'MAHONEY. May I interrupt?

Senator MURDOCK. I hope the author of the bill will say something right now.

Senator O'MAHONEY. This morning, when President Coolbaugh of the Colorado School of Mines was testifying to the effect that the Government had not done sufficient in the United States to advance industry. I was prompted at that time to interrupt him to say that here in the United States we have a very normal and natural suspicion of Government; we have had it over a long period of years; we don't want the Government to interfere with private business. Sometimes I think because of that fear we see dangers where they do not exist, and because we see these dangers we prevent the Government from doing things that ought to be done.

Now, I can testify, as a member of the Senate Committee on Appropriations, that one of the great obstacles to the expansion of the very excellent work of the Bureau of Mines has proceeded from unfounded fears.

Now, I am sure there isn't a person in Salt Lake City, nor a person in the State of Utah, not even the coal operators or operators of any other mining industry, who would for one moment say that the station of the Bureau of Mines here in this city has been anything but a great benefit to Utah and to the mining industry in this State.

I know it is of benefit to the mining industry throughout the West, because the work that is being carried on there is work which, in the very nature of things, cannot be done by private enterprise as successfully as it can be done by the Government, because it is work that is done without profit.

Now, so far as the draftsmanship of the bill is concerned, it was absolutely essential that we should write into it a provision authorizing the Secretary to dispose of the products. If we did not do that, he would have no authority of law to dispose of them, and therefore there would be no way of compensating the Government out of the proceeds of the product of the plant for the expenditures that had been made.

Those of us who sit on the various committees of Congress know that from time to time—particularly those of us on the Appropriations Committee—there are complaints about what are alleged to be the uneconomical practices of Government, that the Government spends too much money.

Now, here is a proposal which I conceive to be of the utmost importance to the coal operators of the West. (Applause.) It will require the expenditure of a large sum of money if we are satisfactorily to test the coal deposits of Utah, Wyoming, Colorado, West Virginia, and other States. And I am sure that neither the coal operators nor any other group need fear any development out of this measure, particularly out of the provision that authorizes the Secretary to make some profitable disposition of the products; you need fear no development which will be at all injurious to free enterprise. On the contrary, I think there can be no doubt that work of this character will do more to build

up the West in the next 10 or 20 years than has been done in all of the years since these territories were settled.

Mr. MANLEY. Senator, we feel that this matter of investigation of natural resources and substances found in these States is particularly and properly the function of Government. We are concerned—I think many people in the Nation are concerned—that we should stop somewhere, and put a stop to Government entering into business. Now, as to how large one of these demonstration plants may become, it may be sufficient to supply a whole city; it would then destroy private enterprise. Would you agree, Senator, that the bill might be limited to a certain tonnage capacity?

Senator O'MAHONEY. The purpose of this study is to discover what should be done, and I think that our decision will necessarily have to be based upon facts and not upon fears. I am really inclined to believe, Mr. Manley, that you are allowing yourself to be unnecessarily perturbed—

Mr. MANLEY. I hope so, Senator.

Senator O'MAHONEY. By apprehensions of things that will never happen.

Mr. MANLEY. They do happen sometimes through governmental action. I do think some limitation should be placed on the size and tonnage of the plant in that case.

Senator MURDOCK. Any further questions?

Mr. G. G. Oberfell, of the Phillips Petroleum Co., was unable to appear in person before the committee, but has submitted a paper and at this time we will ask that it be included in the record.

STATEMENT BY G. G. OBERFELL, OF THE PHILLIPS PETROLEUM CO.,
BARTLESVILLE, OKLA.

SOURCE MATERIALS FOR FUELS AND LUBRICANTS

I. INTRODUCTION

The present national emergency has caused us again to direct our attention to the often reported dwindling petroleum and natural gas reserves of continental United States. And it is right that we should do this since petroleum and the products of petroleum have become very necessary to insure our national welfare both in time of war and in peace. However, since some of us are prone to view the picture of petroleum reserves from the viewpoint of immediate needs, while other are more concerned with what the situation might be some generations hence, many of the statements that are currently made must be confusing to those who are anxious to know the facts and who are also concerned with what our proper course should be for the immediate future.

In considering the problem of future shortages of crude oil we are concerned only with those products from petroleum and natural gas for which satisfactory substitutes from other source materials do not now exist. Answers to questions of how soon we may expect our present source materials for fuels and lubricants to be exhausted and from what new sources we will ultimately derive our fuels and lubricants are largely a matter of speculation. However, it is not too early for constructive thinking as to our future course since only through such an approach will the most be made of our natural sources whether they be oil, coal, or the products of agriculture. The problem must be considered both from the angle of peacetime requirements and from the angle of an emergency such as exists at the present time.

The exploratory studies of the United States Bureau of Mines along these lines of coal conversion constitute a step in the right direction by making available the kind of fundamental information that will help to determine our proper course. Other highly useful information will inevitably come from the increasingly important fields of research undertaken by the United States Department

of Agriculture through the four regional laboratories recently established. The new high pressure thermal and catalytic conversion techniques currently being employed, either commercially or experimentally, in the petroleum industry for the conversion of low-grade petroleum oils and refinery residues to more useful products likewise are adding valuable fundamental information, both technical and economic. The same can be said for the numerous commercial and laboratory processes that have been developed in which natural gas is the basic raw material.

A fund of technical and economic information is being built up in somewhat unrelated fields which will be invaluable in attacking this problem of locating new source materials for our future supply of fuels and lubricants. Even though it may have no immediate application to this problem because, of economic reasons, we are adding information of future value to our technical bank when we develop improvements in such unrelated fields as (1) increasing yields of gasoline and lubricants from petroleum, (2) fixation of atmospheric nitrogen, (3) the chemical conversion of agricultural products.

How soon we will have to turn to sources other than petroleum for our fuels and lubricants is, as has been previously intimated, largely a matter of conjecture. In the following paragraphs an attempt will be made to discuss briefly items which seem to bear on such questions as: How soon will we be faced with a critical shortage; what will be our future requirements as to quality, etc.; should we consider other source materials than coal in such exploratory deliberations. Because of the numerous angles to the problem and because of the importance of certain apparently unrelated items we have adhered to the following outline in our discussion:

1. Future fuels and lubricants and their effect on engine and vehicle design.
2. Future prospects in the field of petroleum production and refining with particular reference to the effect of prices and taxes.
3. Natural gas as a direct fuel and as a starting material for synthetic fuels and lubricants.
4. Other source materials for fuels and lubricants.
5. Petroleum in times of national emergencies.
6. An organized plan of research.

II. FUTURE FUELS AND LUBRICANTS AND THEIR EFFECT ON ENGINE AND VEHICLE DESIGN

Little need be said in regard to the history of the petroleum industry's accomplishments in furnishing fuels and lubricants of constantly improving quality. Developments in refining technology have given us fuels and lubricants with built-in potential values far in excess of the capacity of the majority of present-day engines to utilize such values. These high-octane number fuels and superior lubricants are currently being made from even the lowest grade crude oils in yields that in many instances surpass expectations. It is even more remarkable that during recent years the petroleum industry has been able to make its principal product, gasoline, available in tank-car quantities at wholesale prices averaging 5 cents per gallon in group 3, although out of that return the industry had to pay for the following operations: Extensive exploration to locate new and potential reserves; drilling for and producing the crude oil; transportation of the crude to widely scattered refineries; refining the crude by complicated processes and apparatus requiring constant and expensive rebuilding to avoid obsolescence. It will be extremely difficult to find materials or processes that can compare with this record of achievement on behalf of the consuming public.

Little need be said regarding the possibility of developing higher quality products in the future. There is no reason to believe that the ultimate has been attained in quality of fuels and lubricants, although it is generally conceded that current quality standards should be adequate for some years. It is, however, probable that eventually there will be available at filling stations gasoline from petroleum with an octane rating close to 100 which will be composed largely of synthetic hydrocarbons. Similarly, lubricants will probably consist of highly refined natural oils or synthetic materials, the properties of which may be varied by the use of chemicals called addition agents.

Engines will likewise undergo changes, although the new types of engines should not be expected immediately. Because of the continued developments which have been taking place in the field of petroleum technology, the latest models of cars have not been designed for the best fuels which have been available. The first new cars to be produced in the post-war period will undoubtedly be farther behind the advance in fuel technology than have been the cars in the past. This

condition will be due to the tremendous gains which have been made in the last few years in improved yields and quality of fuels for internal-combustion engines. However, the cars we now have reason to anticipate in the future should give materially lower fuel consumption than present cars because of small, high-compression motors designed for maximum economy rather than flexibility; light bodies due to use of new alloys and plastics; new developments in transmission of power from the engine to the wheels of the car. It is quite possible that these improvements may eventually result in doubling the mileage secured from a gallon of gasoline. With this improvement in gasoline mileage, similar improvement may be expected in the life of crankcase lubricants.

These various remarks convey only the future picture as it appears today, based solely on what has been learned of petroleum products and their utilization. Since new ideas and new developments are daily being unveiled, the picture as we now see it may be greatly altered in the light of such new discoveries as we have every right to expect.

III. FUTURE PROSPECTS IN THE FIELD OF PETROLEUM PRODUCTION AND REFINING

Effect of taxes, crude-oil prices and product prices.—The present stage of development of prospecting methods, production methods, and refining techniques and the probable ultimate effect of their more universal adoption under favorable economic conditions are also of importance. Adverse petroleum prices and petroleum product prices have been a decided deterrent to orderly exploration, to the adoption of efficient production methods, and to the commercial application of new refining techniques.

Since the subject of prices is familiar to everyone, little more need be said about it. It has, however, frequently been stated in oil circles that there are no difficulties currently confronting the petroleum industry that an increase in the price of crude petroleum and refined products would not cure. We must carefully analyze the effect of adverse prices upon these phases of the industry—geological exploration for new reserves, efficient development of proved reserves, development and commercialization of new refining methods, use of petroleum products as substitutes for coal and other fuels.

It is recognized that the collection of taxes is necessary to maintain government, and petroleum products should bear their fair share of such taxes. Care must be exercised, however, to avoid overburdening the industry with taxes, and in certain instances it might prove desirable for the welfare of the Nation to subsidize certain products by removing taxes. In the long run this might be more advantageous than too much subsidy for the development of petroleum substitutes.

Reasonable prices and reasonable rates of taxation should, as a consequence, be made a part of our current studies of dwindling petroleum reserves and improper utilization of petroleum. Under favorable conditions, new reserves will be located and improved production practices will be widely applied that will result in increased ultimate recoveries. As discoveries taper off, attention will be directed to the type of production now classed as marginal. The production of oil by secondary recovery methods such as repressuring and water-flooding will become of increasing importance. The effect will be to extend the economic life of present reserves and thus postpone the time when we will have to look to other source materials for any substantial proportion of our requirements for lubricants and fuels for internal-combustion engines.

Under the same favorable condition of prices and taxes, more can also be expected from the refining branch of the industry. Thus, although the current national average yield of gasoline from crude oil is about 50 percent, the universal adoption of the new processing methods which enhance both yield and quality should raise this materially. Yields close to 100 percent of a superior gasoline at costs that are appreciably less than those anticipated in coal conversion are to be expected. The technology involved in such processing is closely related to, if not identical with, that involved in processes for the liquefaction of coal. Such research and development would, therefore, be of great value to the coal industry, as well as to the petroleum industry.

IV. NATURAL GAS AS A DIRECT FUEL AND AS A STARTING MATERIAL FOR SYNTHETIC FUELS AND LUBRICANTS

The enormous proved and potential natural gas reserves of the United States cannot be passed over lightly. If we disregard the potential reserves, then for purposes of comparisons to be presented in this discussion the proved reserves

alone in the United States may be conservatively estimated at 100,000,000,000,000 cubic feet. On a weight basis these reserves amount to slightly over 2,250,000,000 tons, or more than 70 percent of the weight of the estimated crude-oil reserves of 21,000,000,000 barrels.

The annual production of natural gas in the United States amounts to approximately three trillion cubic feet. On the basis of 0.60 specific gravity this annual production weighs as much as 488,000,000 barrels of 36° American Petroleum Institute crude oil, or 72,000,000 tons. This compares with an annual crude oil production of about 1,500,000,000 barrels and an annual bituminous coal production of about 500,000,000 tons. On a British thermal units basis the annual production of natural gas is nearly 40 percent of the crude oil production and about 25 percent of the bituminous coal production. To users of gas in the areas where gas is produced in large quantity, natural gas may be sold at the well for as little as 5 cents per thousand cubic feet. On a British thermal units basis this compares with 36° American Petroleum Institute crude oil at \$0.27 per barrel at the well and bituminous coal at \$1.09 per ton f. o. b. cars at the mine tipple.

With our enormous reserves of natural gas it is only to be expected that its adoption as an internal combustion engine fuel for automotive equipment will be one of the first considerations toward a new source of material. With the rapid strides that are being made in hydrocarbon synthesis reactions, the reserves of gas have great potentialities in this connection. Liquefied petroleum gases so far have been used to only a comparatively minor extent as direct fuels for internal combustion engines. Any increase in the price of gasoline will have a tendency to increase such usage and at the same time promote the commercial development of marginal processes for converting these liquefied gases to high quality gasoline.

As a direct fuel or as a starting material for synthetic fuels, lubricants, and chemicals, natural gas is probably of as much interest as is crude oil. Many of the techniques developed to harness natural gas, particularly for fuel purposes, should also have application in problems encountered in the utilization of gaseous products of coal conversion.

V. OTHER SOURCE MATERIALS

Considerable information exists in the literature on other source materials for fuels and lubricants. The following appear to be of primary interest: (1) Agricultural alcohol, (2) oil shale, (3) tar sands, (4) conversion of coal.

Agricultural alcohol.—Much has been written about the production of power alcohol from farm products. Thus far, the unfavorable economics have been such as to rule out such possibilities. This does not mean, however, that such a route to our future fuels and lubricants is permanently ruled out. Perhaps the increased knowledge of the chemical utilization of farm products brought about by the foresight of the Congress and the Department of Agriculture in setting up the regional laboratories will make possible the conversion of farm products to fuels and lubricants. The Senate committee under the able chairmanship of Hon. Guy M. Gillette has already gathered much valuable information in this field. We hope that work in this field will be prosecuted diligently by the organizations established by the Congress, and that funds will be supplied to maintain this line of research.

Oil shale.—The processing of oil shales has received less attention in the United States than it has in foreign countries. The shale reserves are, however, enormous and this source of raw material for future fuels and lubricants is a distinct possibility. Studies made to date have shown that oil derived from shale would not be currently competitive with petroleum but that fact does not necessarily rule it out as a future potential source.

The United States Bureau of Mines has carried on considerable work in the field of oil shale utilization, in fact the only work of any consequence that has been done in this country. With admittedly fragmentary information on the subject it is conceded that we have over 100,000,000,000 barrels of oil in the form of shale deposits. Any forward-looking program must take these reserves into consideration.

Tar sands.—Enormous deposits of so-called tar sands which occur in northwestern Canada and in smaller quantities in the United States also have future possibilities and may possess even greater promise than do oil shales. Some limited information available indicates that fuels could currently be made more economically from oil shale and tar sands in certain favorable instances than

from coal conversion. Certainly careful study should be given to these materials along with other possible source materials.

Coal conversion.—It cannot be denied that coal and water represent a tremendous reserve of carbon and hydrogen, the source materials for a wide variety of organic chemicals, plastics, etc., as well as fuels and lubricants. Progress in the conversion of coal is as yet in its early stages even though many foreign countries look to coal for a substantial portion of their fuel and lubricant supplies. It is expected that much of the knowledge that has been accumulated in the last few years in the conversion of petroleum will find application in coal conversion. The tremendous reserves of coal, the enormous investment already existing in the industry, developments in hydrogenation technique and the possibilities of lower costs for the manufacture of hydrogen, all strongly point to the advisability of immediate and extensive research work in coal conversion.

VI. PETROLEUM IN TIMES OF NATIONAL EMERGENCY

Although there are many source materials which could be considered as petroleum substitutes, for times of national emergency there is as yet no satisfactory substitute for petroleum. Petroleum is a convenient, high-grade, and valuable raw material which requires fewer operating steps in converting it to war materials. For this reason the intelligent use of petroleum reserves in order that there may be adequate supplies for use in a national emergency would seem essential in the national interest.

VII. AN ORGANIZED PLAN OF RESEARCH

If we are to provide adequately against the possible future needs of the Nation for liquid fuels and lubricants it seems evident that a carefully organized plan of research must be worked out. We cannot leave the matter by simply stating the case to the general public, nor can any one industry solve all the problems involved. On the other hand industries should be encouraged to attack the problems confronting them and governmental agencies should utilize to the fullest extent the accumulated knowledge of industry. In this way duplication of effort can be avoided and the time hastened when we shall have found an adequate answer to the question: Where shall we find sufficient liquid fuels and lubricants for our future needs?

SUMMARY

1. Developments in fuels and lubricants and in engines and vehicles will result in more miles per barrel of crude oil; it is reasonable to hope for four times present mileage.

2. We do not know what may be the distant future quality of fuels and lubricants. Any source of carbon and hydrogen may be a possible raw material. All such sources should be adequately investigated. The tremendous reserves of coal, the enormous investment already existing in the industry, developments in hydrogenation technique, and the possibilities of lower costs for the manufacture of hydrogen, all strongly point to the advisability of immediate and extensive research work in coal conversion.

3. Since manufacture of fuels and lubricants is becoming more of a problem of chemical synthesis we must use more and more the information acquired from hitherto unrelated fields of endeavor.

4. Proper handling of prices and taxes may do much to lengthen the life of our petroleum reserves.

5. Serious consideration should be given to the use of our natural-gas reserves as a means of extending our petroleum supply. On a British thermal unit basis these gas reserves are equivalent to 22,000,000,000 barrels of gasoline.

6. The intelligent use of petroleum reserves should be observed until satisfactory substitutions are found, in order to assure our future national security.

7. Greater attention should be given to research on the chemical utilization of agricultural products.

Senator MURDOCK. We will now hear from Mr. George W. Carter.

**STATEMENT OF GEORGE W. CARTER, ASSISTANT PROFESSOR OF
MECHANICAL ENGINEERING, UNIVERSITY OF UTAH, SALT LAKE
CITY, UTAH**

Mr. CARTER. My name is George W. Carter, assistant professor of mechanical engineering at the University of Utah. I think, in the interest of conserving time, with your permission, I shall read my paper.

**UTILIZATION OF WESTERN CARBONACEOUS DEPOSITS FOR THE PRODUCTION
OF OIL AND RELATED PRODUCTS**

It is indeed gratifying to know that this Government is looking toward coal and other carbonaceous materials as a future source of oil. We may not be fortunate to discover new and extensive pools of natural petroleum in this country as we did after the last war. We, therefore, must be prepared to supplement our supplies of this vital fluid from other sources. Certainly now is the time to start the ball rolling in this direction.

Utah is known throughout the land as the State which originally was inhabited by the courageous Mormon pioneers. This State likewise is known to be the source of many processes for the development of its vast deposits of coal and other solid hydrocarbons. In fact, those of us who have been at work on this problem have gained special notoriety in some quarters. We have heard that we are irrational dreamers, wasting time on a matter which is fundamentally unsound and of little use to mankind. Be this as it may, we still hold that some day in our glorious West, birth will be given to plants successfully engaged in the processing of solid fuels for oil, coke, and other products essential to our Nation's progress.

I understand that this hearing is for the express purpose of receiving opinions on how to most effectively utilize western resources for oil production. These resources comprise coal, lignite, oil-shale and bituminous sandstone. Since my experience largely has been with coal, I shall confine my remarks chiefly to this mineral.

The production of synthetic petroleum in this country presents many problems which require time and thorough study for their correct solution. We can touch only upon the high lights today.

Solid hydrocarbons may be made to yield liquid fuels by processes of (1) hydrogenation to form directly gasoline and related products, and (2) low- and high-temperature carbonization to produce a heavy tar-oil which may be either hydrogenated or cracked to make gasoline. Hydrogenation produces liquid and gaseous fuels only, while carbonization produces a solid fuel or coke in addition to the above fuels. I favor low-temperature carbonization to other types of carbonization because this system yields considerably more tar-oil and also produces a free-burning solid smokeless fuel from coal.

Although they are not of recent origin, both hydrogenation and low-temperature carbonization are in the development stage in this country. Of the two methods, low-temperature carbonization has had the most colorful career. In the early days of its history large sums of money were lost in commercial ventures of one kind or another, and the public soon became skeptical. However, the art has advanced mate-

rially since then and our knowledge of coal has made remarkable progress. The Pittsburgh Coal Carbonization Co. has been producing low-temperature coke and liquid byproducts in commercial quantities for some time, and other United States companies are carbonizing lignite to make briquetted fuels. On the other hand, hydrogenation has not yet been undertaken in this country except on a laboratory scale. In other nations, notably Great Britain, Germany and Japan, both hydrogenation and low-temperature carbonization have been in commercial use for some time. Technical journals from these countries have long been filled with results of research conducted in both fields.

With regard to the western region I think that the status of hydrogenation and low-temperature carbonization are pretty much the same. That is, they have been subjected sufficiently to laboratory analysis and now are ready to be studied further by the operation of demonstration plants. I believe that there are worth-while developments to be made in both fields and strongly urge that this committee and the Bureau of Mines give adequate attention to them in the proposed program. I also suggest that due consideration be given to each of the solid hydrocarbons in order to determine fully their potential value as producers of oil.

In one respect the problems involved in carbonization are somewhat more complex than those for hydrogenation. I refer to the fact that there is one method proposed for hydrogenation, namely that of the Bureau; whereas there may be several processes suggested for low-temperature carbonization. However, this matter is not impossible to solve, and it may be wise to incorporate more than one process in demonstration plants.

According to Dr. Fieldner and Mr. Rice of the Bureau, writing jointly Technical Paper No. 4 of the National Resources Planning Board, October 1941:

The best available estimates on the cost of production of synthetic gasoline by coal hydrogenation are given in the reports of the Committee of Imperial Defense of Great Britain and the Labor Party of England.

After reviewing the reports cited, I have concluded that a hydrogenation plant capable of producing 1,000 barrels of gasoline per day would cost approximately \$9,000,000. One Utah bituminous coal which the Bureau has studied yields 136 gallons of gasoline per ton. Assuming a plant life of 15 years and accounting for costs of fuel, supplies, labor, and other overhead charges, the cost per gallon of gasoline would be from 16 to 18 cents per gallon. So far as I know, these figures represent the actual cost exclusive of the manufacturer's profit.

A low-temperature carbonization plant with a modern oil-cracking and refining plant to produce 1,000 barrels of gasoline daily, would cost in the neighborhood of \$4,000,000. Carbonizing 1 ton of Utah bituminous coal yields 25 gallons of tar oil and 0.67 ton of solid smokeless fuel. Cracking this quantity of oil yields 6 gallons of better than 70 octane gasoline. In order to estimate manufacturing costs on a basis comparable with that for the hydrogenation figures, I have considered the carbonization and cracking plants to be located together at the mine. The total cost of carbonizing 1 ton of coal would be \$2.50; \$1.55 of this sum would pay for the coal and the remainder, or \$0.95, would take care of all operating expenses includ-

ing overhead. In order for the solid fuel and crude oil to assume their fair share of the total production cost, I have estimated the solid fuel to be worth \$4.25 per ton and the tar oil 3.3 cents per gallon at the plant. This means that the \$2.50 spent per ton of coal would be balanced by a revenue of \$1.94 from 0.67 ton of smokeless fuel and \$0.56 from 25 gallons of tar oil. Thus, 1 barrel of oil would cost 94 cents at the plant. By first removing 40 percent of the tar in the form of phenols and cracking the remaining neutral oil to coke, 6 gallons of gasoline would be produced per ton of coal or per 15 gallons of tar on the basis of 94 cents per barrel, the cost of 1 gallon of gasoline would be about 10 cents. The expense of removing the phenols would be charged to the production cost of creosote, flotation reagents, and other products derived therefrom.

The fixed gases derived from carbonization may be scrubbed to yield 1 gallon of benzol per ton of coal, thus making the total amount of motor fuel equal to 7 gallons per ton of coal. On this basis, 6,000 tons of coal would be required to produce 1,000 barrels of gasoline by low-temperature carbonization of Utah coals. By hydrogenation, only 310 tons of coal would be needed for the same yield of gasoline at the rate of 136 gallons per ton of coal. Considering the production of motor fuel alone, it may be wiser from the standpoint of coal conservation to employ hydrogenation even though the cost of this gasoline may be almost double that produced via carbonization. However, should the properties of the two fuels differ widely, they could not be evaluated on the basis of cost alone. Then too, this economic comparison may not be valid for other coals of the West. We cannot do more than make certain preliminary estimates at this time: we must try both methods before their places in synthetic oil production can be ascertained with certainty.

I have long contended that low-temperature carbonization holds possibilities that hardly have been touched. For example, if we had a plant in operation in this State today, we would sell smokeless fuel for use in chicken brooders which have been deprived of their normal supply of petroleum carbon; and we would sell the tar oil to a Utah coal-tar refinery for the manufacture of essential war items. Other war applications would be found for the low-temperature coke, such as mixing it with a coking coal to produce a better blast-furnace coke. This scheme has received attention by the Colorado Fuel & Iron Co. at Pueblo, Colo. Some low-temperature carbonization processes also produce a surplus fuel gas of high-heating value which may be used to supplement present supplies of gaseous fuels. As I understand it, all of the fixed gases from hydrogenation are used in the process itself.

Coupled with these important applications, my associates and I have proposed the production of smokeless fuel in cylindrical form from noncoking Utah coals, followed by further heating of the logs to high temperatures to form blast-furnace coke. Further research is required to make certain that the heating of the logs to high temperatures can be accomplished without their disintegration, and also to determine the physical characteristics of this fuel in relation to those of byproduct coke. If this method and our present calculations should be proven reliable, a commercial plant would cost no more than beehive ovens of equal daily capacity and would produce 32 tons of the

new coke in the same time that 1 ton of beehive coke or 4 tons of by-product coke are made. Moreover, the range of suitable coals for coke-making would be extended materially beyond the limited resources of western coking coals used today. Other groups may find new applications for low-temperature carbonization as time goes by, especially if given encouragement by Federal and State Governments.

I think that we could discuss the merits of the many liquid and other byproducts of hydrogenation and low-temperature carbonization for the rest of the day. Afterwards, I am sure we still would not have arrived at definite conclusions in all major respects. This is fundamentally impossible, because we need demonstration plants and all of the data they would afford before this important matter can be settled.

My opinions may now be summarized as follows:

(1) Both hydrogenation and low-temperature carbonization demonstration plants should be erected in the West. I am convinced that there are worthwhile developments to be made in both fields which need not be necessarily competitive.

(2) These plants should be so designed and the processes so chosen that tests can be made using oil-shales and bituminous sandstones as well as coal and lignite. In this way, the potential value of these hydrocarbons as oil producers may be evaluated.

Mr. CARTER. Since I prepared this report, I discovered that I neglected to include the number of tons, approximately, which would be required per ton of coal hydrogenated. According to the information I have, that figure would run from about $3\frac{1}{2}$ to 4 tons of coal which would be needed for fuel and other purposes, along with 1 ton of coal which is hydrogenated. So perhaps this figure would run, maybe, 1,200 or 1,500 tons of coal per 1,000 barrels of gasoline per day.

Senator MURDOCK. Are there any questions? (No response.)

Thank you very much, Mr. Carter.

Senator MURDOCK. Mr. J. C. Gudgell.

STATEMENT OF J. C. GUDGELL, OF INLAND HYDROCARBON CORPORATION, SALT LAKE CITY, UTAH

Mr. GUDGELL. My name is J. C. Gudgell. I am connected with the Inland Hydrocarbon Corporation. We investigated the oil sands in the Uintah Basin some 3 years ago. I will make this very brief. We found unusual properties, as has been stated prior in this investigation and hearing, as to quantity, quality, et cetera, of the Uintah Basin oil from the oil sands, which differs from the asphalt rock considerably—just a sand with oil in it. We went into the research privately, as a corporation, to develop these properties, and spent considerable money thereon. We found it a tremendous job, too big for such a small corporation; we need Government help. The Government owns four or five times as much of this property as we do, and we lease a good many hundreds of acres.

I will not attempt to go into any chemical analysis or description of the material, as I would like to call on Professor Ball of the Colorado School of Mines to give you a brief summation of that. I will merely say that we have developed a process for separating the oil from the sand by a very cheap method. We want to impress upon this committee that we would like to count on the help of the Government to con-

tinue the research, and, in so doing, also to install a pilot plant of research type of about two or three hundred barrels per day capacity in the Uintah Basin for this purpose. It is for the good of the people of Utah, for the good of the country as a whole, besides the fact that we are selfishly interested in these properties.

I wonder if it would be possible to call on Professor Ball for a brief statement of the possibilities involved. We have taken this matter up with the Government before, and have and are now discussing it with them, but so far it has been a lot of red tape. But I think this bill is good and should go through, by all means.

Senator MURDOCK. Do you want to submit the report that you have here?

Mr. GUDGELL. In submitting this report, I am not at liberty for myself and from my company's standpoint, to let it go into the record. From the standpoint of the Government, for whom this report was gotten out, they have written to Mr. A. S. Brown, stating that certain parts were confidential. Therefore, they did not want it of record. As for us, that is not necessary, it is not confidential from our standpoint. I submitted it to Senator O'Mahoney and he can take the matter up, and if it is agreeable it is all right; otherwise, it is for his information.

STATEMENT OF JAMES O. BALL, COLORADO SCHOOL OF MINES, GOLDEN, COLO.

Professor BALL. My name is James O. Ball, connected with the Colorado School of Mines. Mr. Gudgell asked me if I would make some comment upon those sand deposits. I do not have a prepared statement on that subject. I might start out with saying that there has been very little work, practically no work, done on the tar sand or bituminous sand in the Uintah Basin. I have heard some comment made, but have been unable to find any work at all. I have devoted considerable time in the last 2 years to the matter. The Athabasca Tar Sands Co. of Canada has done considerable work over 15 years and is still engaged in the work. The Canadian Government appropriated \$300,000, and I understand recently they appropriated more money for research work on the Athabasca sand. We have done nothing in this locality at all, and I think it is worthy of research, for this reason: It is another source of hydrocarbons, a potential source; we have some reports as to the amount of oil available from the United States Geological Survey, and it is mentioned in the report that has been handed in, and it has been estimated there is at least 2,000,000,000 barrels in one deposit. There are many deposits in Utah and Colorado. The sands extend over into Colorado, but Utah apparently has the largest deposit; I think those sands are worthy of some research and should not be passed up. That is about as far as I can go as to giving you information on these sands; I have found some statistical data but I am not going to burden you with it as it is highly technical. I will say, however, that there are many interesting possibilities in these sands, and I am of the opinion they ought to be investigated.

OIL SHALE

With regard to oil shale, I feel this way about producing oil from oil shale: I take the standpoint, not oil from oil shale, but products from oil shale. I say products from oil shale rather than oil from oil shale. I think shale oil will produce just as much gasoline as petroleum will and I think it will produce gasoline at a cost very little in excess of that produced from petroleum. Now, I am not giving any figures, but if anyone wishes to question me technically, they may want to know how I arrive at that conclusion, but I can give that in very few words. It is not only my notion; there are men connected with the oil industry that have also come to that conclusion. I am not giving you a figure of \$1 or \$3 per barrel. My figure is, we can produce gasoline from oil shale at a cost comparable to that in the petroleum industry.

COST OF RETORTING AND REFINING

Much has been written about the cost of retorting oil shale and the refining of shale oil. These two operations have usually been considered as separate processes; however, in the light of methods developed for the extraction of oil from shale in recent years, and also of the advances made in refining during the past 15 years, both of these operations may be considered as being component operations of one process in the production of motor fuels and other hydrocarbon products. By combining the operation into one process the cost of producing marketable products is reduced.

In estimating the cost of retorting and refining of shale oil consideration must be given to the richness of shale and the kind of product desired. Selecting gasoline as the desirable main product, and retorting shale containing approximately a barrel of oil per ton, a reasonable comparison of costs of gasoline produced from shale oil and petroleum can be made. The cost of retorting can be approximated by considering this cost as being approximately the same as that of topping crude petroleum. As gasoline is to be the main product, the shale oil will be cracked to produce the maximum yield of gasoline. Cracking costs for shale oil will be about the same as those for cracking petroleum. The combined cost of retorting a ton of shale and cracking the oil to produce a maximum yield of gasoline should then be approximately the same as that of topping and cracking a barrel of crude oil.

There is no way in which to make a comparison of treating costs for sulphur and nitrogen. The cost of treating gasoline produced from oil shale will depend upon the method of recovering the oil from the shale. However, the costs will not be lower than those for treating gasoline produced from petroleum. Analyses of shale oil show that the sulfur content is low, this treating cost should be comparable to that of ordinary gasoline. The presence of nitrogen shown by the analyses indicates that a treating cost must be added for its removal, but this should not be difficult nor costly.

In order to arrive at an over-all cost of finished products, it will be necessary to add to the costs just estimated, those of mining, crushing and water disposal. If these combined costs just mentioned are not above the cost of a barrel of crude oil, then the total cost of pro-

ducing gasoline and other products from oil shale will approximate closely that of gasoline and other products produced from petroleum.

Many unknown facts have been used in the above estimated costs, but it is my opinion that technical investigations will reveal their correctness.

Senator MURDOCK. Thank you, Professor Ball.

Our next witness is Arthur L. Crawford, geologist and mineral technologist at the University of Utah. Will you come forward, Mr. Crawford?

STATEMENT OF ARTHUR L. CRAWFORD, GEOLOGIST AND MINERAL TECHNOLOGIST, UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH

My name is Arthur L. Crawford. I am the geologist and mineral technologist for the Utah Engineering Experiment Station, University of Utah. I first became interested in the study of the Green River oil shales in connection with a more detailed geologic investigation of gilsonite,¹ a unique, valuable, solid hydrocarbon which I am convinced was formed either directly or indirectly from kerogen—the mother bitumen from which oil is produced when these bituminous shales are subjected to heat.

It is the possible byproducts, such as valuable hydrocarbons and the metal vanadium, that might be extracted from this kerogen, as a means of lowering the cost of producing oil and gas from it, that I have been requested to emphasize in my testimony.

In order to keep within the time allotted, I shall read what I have to say.

POSSIBLE BYPRODUCTS FROM THE KEROGEN OF UTAH OIL SHALE

Utah has never had the advantage that comes from the development of a large petroleum field within her borders. However, Utah is fortunately blessed with more than her share of the rich oil-producing coal and oil shales upon which it now appears that we must rely to supply our future needs of liquid fuel. The rich oil-producing coals of Utah and the kerogen shales laid down at a subsequent geologic period have resins, waxes, and other related hydrocarbons associated with them not only as veins in the surrounding rocks but also as dissolved or embedded constituents which owe their existence to the peculiar conditions of original sedimentation and to the fractionating processes which nature has provided since.

If research can provide us with an inexpensive means of separating these valuable byproducts, the oil and gas can then be produced more cheaply.

The basic investigations of our oil shale resources were made immediately before and following World War I, when it appeared that our reserves of natural petroleum were nearer exhaustion than they subsequently proved to be. I remember well that upon entering Stanford University, the professor emeritus, internationally known for his oil studies, advised me strongly against specializing in petroleum geology, since, as he put it, all of the major fields would be discovered and mapped within 5 years. Subsequent

¹ See Utah Gilsonite and Related Hydrocarbons, by Arthur L. Crawford, the Utah Industrial News, July 1942, p. 7.

discoveries completely upset the estimates based upon his mature judgment. I mention this in passing to illustrate what may happen to some of the pessimistic predictions we now hear.

There are factors which might change the whole picture, not only with regard to our national position as a declining exporter of oil, but also with regard to the importance kerogen shales will assume as a source of this oil. To illustrate, it might prove, as claimed by Kerrick,² and certain other engineers, that it is economically possible to distill underground oil and gas from our kerogen shales, rock asphalts, and other bituminous beds. If so, this would render unnecessary the great expense of mining, moving, and disposing of vast quantities of rock, and would eliminate the waste involved in leaving untreated a high percentage of the material as pillar supports in the mine.

Likewise, the picture would change if, as indicated by research we have begun, vanadium and other valuable byproduct elements and compounds should prove to be present in the kerogen of the oil shale in significant quantities. Ways and means might then be devised so that these byproducts could be made to carry a large percentage of the cost of extracting the oil. There are two kinds of byproducts that might prove economically important—organic and inorganic. I shall give one illustration of each.

Ozokerite, the nearest mineral equivalent we have to the wax of bees, is a valuable organic substance worth from 25 cents per pound up. It is always in good demand, and just now commands its own price, since nowhere else except here in Utah is it produced commercially outside of Galicia in Axis-dominated Poland. There are sound reasons for believing that continued diligent research on the properties, origin, chemical constitution, and methods of fractionating the constituent substances in the kerogen of oil shale would result in our being able to extract or synthesize ozokerite and the other valuable hydrocarbons which nature has, in my opinion, derived from this kerogen.

Of the inorganic byproducts, vanadium is the most promising. Heretofore, so far as I am aware, oil shales have not been examined for vanadium. Several assays just completed, since this hearing was scheduled, show a V_2O_5 content of around 0.75 percent for a composite sample of certain rich kerogen shales a few miles north of, and only a few hundred feet stratigraphically above, the Dickinson ozokerite mine at Soldier Summit, Utah. This sample was taken under the sponsorship of the Utah State Department of Publicity and Industrial Development in cooperation with the Utah Engineering Experiment Station of the University of Utah. Mr. Alfred M. Buranek, geologist for the department, and I, representing the University of Utah, have been extremely interested in the extent, distribution, and origin of the vanadium deposits of this State.

Several samples taken by Mr. Buranek of carbonaceous shales varying in age from pre-Cambrian to Tertiary show the general affinity of vanadium for carbonaceous material. A resinous coal from Deer Creek in Huntington Canyon, Emery County, Utah, assayed 0.1 percent V_2O_5 , and a cannel coal from southern Utah assayed twice as much.

As you know, vanadium is one of the important war metals which we have in the past brought in from Peru to supplement our domestic

² Oral communication of Lewis C. Kerrick, formerly fuel technologist for the U. S. Bureau of Mines, now consulting engineer, Salt Lake City, Utah.

supply. To aid in the war effort the new mill at Monticello, in southeastern Utah, was finished a short time ago to treat the carnotite and allied vanadiferous ores of that vicinity. It was designed to treat 1.5 percent V_2O_5 ore. However, it is reported that ore averaging but 1 percent is being purchased and treated along with sufficient high grade to make it reach the required average V_2O_5 content. Known reserves of even this lower grade may prove inadequate to sustain continued production of this mill.

If, as indicated by the above-mentioned assays, it should develop that the rich kerogen shales of Utah and Colorado average around 0.75 percent V_2O_5 , the future vanadium supply of the United States would be assured. The large tonnages involved, if linked with a shale oil industry, should lower the cost of treatment to a point where 0.75 percent V_2O_5 would become commercial ore. The treatment of the shale to recover its gas and oil might then become the byproduct industry and the cost of the oil cheaper than that from other sources.

Senator MURDOCK. Any questions of Mr. Crawford? Thank you, Mr. Crawford. Our next witness is Paul Buhlig, of Pasadena, Calif.

**STATEMENT OF PAUL BUHLIG, OF FOLEY BROS., INC.,
PASADENA, CALIF.**

Mr. BUHLIG. My name is Paul Buhlig, of Pasadena, Calif. I am associated with Mr. E. T. Foley, who is one of the Foley Bros., Inc., nationally known contractors. I wish to present to the committee information concerning the property in which we have been interested for some time in California.

Let me state at the beginning, gentlemen, that I personally, and my associates, are for the bill. We are for all parts of it, and we would like you to know that. As a matter of fact, we were about to submit a report to an agency of the Government. I was preparing part of it, and our technical men were preparing part of it. Having heard of this meeting, I decided to come up here to meet with you gentlemen, because we want to do our part in helping the war effort. The proposal that I have to make here is along a little different line, I think, than anything that has come up so far today, in that I have definite figures and definite things, because we have been working on this for quite a long time. We have a small property which is oil-impregnated, diatomaceous earth, and what I have to say about that may tie into a lot of things that have been said here today.

Senator O'MAHONEY. What does this diatomaceous earth produce?

Mr. BUHLIG. Diatomaceous earth produces—well, the Johns-Manville Co. has a big plant in California, about 4 or 5 miles from our property; this is a poor diatomaceous earth and not impregnated with oil, and it produces all sorts of filter materials and insulating materials. I think diatomaceous earth is one of the best things to use for lining retorts at very high temperature.

Senator O'MAHONEY. It doesn't produce liquid fuel?

Mr. BUHLIG. Not diatomaceous earth, but our deposit, at a subsequent time after it was laid down by marine plants, became impregnated with oil through volcanic action, so it is now impregnated with this oil; and over a period of about 4 years we have been experimenting with it in order to find out just how we could get this oil out.

It is a simple matter; the oil is not in chemical composition with the substance, as it is in the shales, but it is in physical composition; merely heat is necessary to bring it out, but it is quite a tricky process, nevertheless. Dr. Coolbaugh touched on some of the problems this morning, but without going into the details of any of the problems I think we have practically all of them overcome. At the present time there is an enormous oil shortage, as we all know, developing in California. This property is located about 150 miles north of Los Angeles, near Santa Maria, about 5 miles from a deep-water harbor. The deposit, the geologists say, is between 2,000 and 2,500 feet thick.

Senator O'MAHONEY. Do you have a report from a geologist?

Mr. BUHLIG. Yes.

Senator O'MAHONEY. I suggest if Mr. Buhlig would have an abstract of that report made and submit it to the committee we would be very glad to have it examined by the experts at the Bureau of Mines.

Mr. BUHLIG. I would be glad to do that. I have some material here now; it is not exactly as conclusive as I would like to have it, but it contains most of the information. The point I wanted to make, Senator, if you will bear with me for just a minute—I know we are all tired and it is getting late—we want to cooperate in every way that we can in furnishing what information we have developed; and we feel that if an appropriation could be made for the development of that property a great deal of fuel oil might be secured in connection with the present war effort, and take care of gas shortages which are now developing, as we all know, in California and in the other markets.

Senator MURDOCK. Whatever you want to submit to the committee we will be glad to receive.

Mr. BUHLIG. I think that is the way to do it.

Senator MURDOCK. Congressman Randolph wants to ask a question.

Congressman RANDOLPH. Could this be strip-mined?

Mr. BUHLIG. This lies up on top of a hill, about 1,000 to 1,300 feet above sea level. It is material which would be easily accessible with strippers or shovels. Another point I wanted to make, this oil is like the Santa Maria crude; we can produce it, we think, and we are prepared to make a proposition so far as the oil is concerned, and I think at a considerable saving over Santa Maria crude. Santa Maria crude is now selling at about 80 cents a barrel. Does that answer your question, Congressman Randolph?

Congressman RANDOLPH. It does, sir.

(The statement referred to by Mr. Buhlig is as follows:)

OIL SHALE (DIATOMACEOUS EARTH) DEPOSIT NEAR SANTA MARIA, SANTA BARBARA COUNTY, CALIF.

DEPOSIT AND LOCATION

Approximately 900 acres of oil shale (diatomaceous earth impregnated with oil) in the Casmalia oil field near Santa Maria and about 175 miles north of Los Angeles, Calif. The Southern Pacific Railroad circles the property. A deep-water harbor at Point Sal is 5 miles distant, and deep-water oil-loading facilities are only a few miles south of Point Sal.

GEOLOGY

The geology of the deposit is simple. It lies across the axis and on the flanks of a sinuous and faulted fold known as Schumann anticline. The oil is in physical and not chemical combination with the diatoms. Most of the deposit lies

below sea level and estimates of depth of the deposit vary from 2,000 to 5,000 feet.

AMOUNT OF OIL AVAILABLE

Above sea level the deposit averages 600 feet in depth, as shown by test cores, and engineers have estimated the per-acre yardage to be about 1,000,000 cubic yards of mineable above sea level. Experiments have proven that a cubic yard, which is about a ton, will produce about $1\frac{1}{2}$ barrels of oil, so that on a conservative basis in excess of 1,000,000,000 barrels of oil are recoverable above sea level. Without doubt, the below-sea-level material can also be easily recovered, so that, since the deposit has probably a more or less uniform impregnation throughout, the total amount of easily recoverable oil is 2,000,000,000 or 3,000,000,000 barrels, or even more.

EXPERIMENTATION AND RESULTS

The preliminary and experimental work has all been done. After 4 years of continuous work with the best experts available, a continuously operating pilot plant (capacity about 1 ton each 8 hours) was perfected. We are not prepared to furnish oil in large quantities on a contract basis, and an almost limitless amount of crude distillate can be made with the proper equipment and laid down only 5 miles from deep-water harbor on the Pacific.

PROCESS

Since the oil is in physical and not chemical combination with the diatomaceous earth, the process is much simpler and cheaper than in regular oil shales. Only heat is necessary but the processing of a large amount of material is tricky which accounts for the considerable amount of time and expense that have been spent. The machine consists of an upright retort in which crushed raw material is inserted at the top, the oil extracted and calcined diatomaceous earth discharged at the bottom, speed of movement and heat being most carefully controlled to insure continuous operation.

OIL

The oil is similar to Santa Maria, California, crudes with a gravity of 12° or 13° A. P. I., but higher gravity oil can be produced by varying heat and pressure. Like all Santa Maria crudes the oil is high in sulphur content, varying from 5 to 7 percent. It produces higher octane gasoline than usual heavy crudes.

BYPRODUCTS

The principal byproduct is calcined diatomaceous earth, but other important byproducts of the process are carbon dioxide (dry ice), sulphuric acid and activated char for filter purposes. Markets can be developed for all of these in varying quantities. The oil like all Santa Maria crudes (and only these) probably contains a percentage of vanadium which doubtless can be recovered in the usual manner from soot and ash. This angle could be of highest importance.

SPONSORS AND DEVELOPERS

E. T. Foley, who lives in Pasadena, of Foley Bros., Inc., one of the important contractors of the country and miners of strip coal on a large scale, together with associates including the writer have the predominant interest in the deposit. An organization is ready to perform under this project, including M. Foley, the writer, a plant superintendent and an engineer both of whom have been associated with the project during all its preliminary stages.

PROJECT

The immediate development of the property would really be an advance on the proposals in these hearings, as the experimental work is finished. The method is demonstrated and the need for the oil now exists in the Pacific coast market. Almost any quantity of crude distillate can be produced at a considerable discount below present prices for fuel oil or for Santa Maria crude.

The amount of money needed would be approximately \$1,000,000, of which \$200,000 represents installation work, camps, buildings, and developments; \$120,000 represents stripping and quarrying equipment; \$100,000 represents crushing and conveying equipment; \$400,000 represents distillation equipment, including retorts, etc., and \$180,000 represents contingencies and reserve for alterations and improvements.

This plant would not be an experimental unit as such but would be the first unit of the installation and would produce about 1,500 barrels of oil per day. Additional 1,500-barrel distillation units could be erected at a very considerable saving.

Given the necessary equipment and material this operation could be gotten under way very quickly and supply in addition to, say, 10 percent of high-octane gasoline a vast quantity of fuel oil at tidewater for use in the Pacific at a great saving to the Government.

STATEMENT OF H. H. CANNON, CONSULTING ENGINEER, GLENDALE, CALIF.

FOLEY-CANNON DISTILLATION PROCESS

The geology, location, etc., of the deposit of diatomaceous earth together with reports of earlier work have all been covered elsewhere and have no proper place here, but before entering into a description of the process involved, a brief statement as to the nature of the material under discussion is in order.

In some earlier geologic period an enormous deposit of "diatomaceous earth" consisting mainly of the skeletons of marine diatoms was laid down. This type of diatom leaves a skeleton of siliceous material which is extremely porous. During some later period of time the entire deposit became saturated with a heavy tarry crude oil, thus producing a vast reservoir of oil reaching from practically the surface of the ground to depths of several hundred feet.

The deposit is of an entirely different character than any oil shale, in that the oil content may be readily leached out by suitable solvents, whereas from a true oil shale little or no oil can be recovered by this means. The applicability of the Foley-Cannon process to the recovery of oil from shale has not been demonstrated.

THEORETICAL CONSIDERATIONS

The development of a process for extracting the oil was instigated initially by Mr. E. T. Foley, who was apparently the first man to realize that one of the main obstacles to the recovery of the oil contained in the deposit involved the handling of large tonnages of material at low costs. Mr. Foley's success as a mover of material needs no elaboration, but it is rather obvious that all earlier experimental work had been carried on by men with little or no conception of the task confronting them in this respect. A good deal of the earlier work had been directed by men thoroughly competent in chemistry and engineering but lacking experience in handling materials of this nature in large quantities.

THE FOLEY-CANNON DISTILLATION PROCESS

In this process a simple vertical retort is used employing relatively high temperatures and high flue gas velocities with little or no pressure. In beginning the distillation process the retort is loaded with fresh shale approximately its full length and hot combustion gases from a separate combustion chamber are introduced into the retort

at the bottom, heating the lower portion of the shale above the ignition point of carbon. Air is then mingled with the flue gases from the combustion chamber and forced into the retort. This introduction of air causes the ignition of the shale in the bottom. The intensity of combustion is regulated by the amount of air introduced and the resultant combustion gases ascending through the shale mass distill out the petroleum products. Speedy distillation requires sufficient heat to crack portions of the oil gases which leaves in the spent diatomaceous earth or shale a carbon or soot residue. After the operation is under way combustion gases from the combustion chamber are replaced with combustion gases from the operation itself, so in effect it becomes self supporting.

In practice the operation of the retort may be roughly divided into four zones. Commencing at the bottom, the first zone might be described as the cooling zone where a mixture of air and of recirculated combustion gas generated by the operation itself cool the calcined shale and in the process are heated above the point of combustion carbon. The next zone is the combustion zone wherein the spent shale is calcined by burning out of it the carbon deposited in distillation. The next upward zone is the distillation zone in which the ascending gases distill the oil out of the raw diatomaceous earth or shale.

Complete control of the operation is maintained by regulating the amount of oxygen introduced, and the temperatures of the various zones are maintained at required temperatures by the use of thermo couples.

The mixed flue gases and petroleum gases emerging from the top of the retort are piped to a condenser after passing through a contrivance which removes all shale dust. After the oil gases are condensed a portion of the remaining combustion gases are recycled, mixed with oxygen and introduced into the bottom of the retort as above described. The amount of air is accurately regulated to get the allowable combustion in the retort which must be short of clinkering temperatures.

It so happens that the amount of carbon deposited in the shale in the process of distillation is sufficient to provide, in the calcining process above described, sufficient hot gases to crack and distill out of the raw shale their petroleum gases so the process is continuous. Constant operation is secured through an arrangement of valves which permit the continuous introduction of raw shale at the top of the retort and the continuous withdrawal of calcined shale at the bottom.

**STATEMENT BY E. T. FOLEY, FOLEY BROS., INC.,
PASADENA, CALIF.**

**ESTIMATED COST OF DISTILLATION PLANT 1,000-TON CAPACITY PER DAY
EXCAVATING EQUIPMENT**

It is probable that at the top and along the sides of the deposit stripping to a maximum depth of 30 feet should be performed with grading equipment such as power shovels, trucks, and/or tractor scraper and the waste transported by belt conveyor and deposited by stacker into waste dumps just below the oil-enriched zone. This is a relatively simple and cheap operation.

The most efficient manner in which the stripped shale can be excavated and transported to the reduction plant is perhaps by the use of tractor scrapers after the stripped shale has been loosened with a ripper but it may develop that a power shovel operation will be preferable. After being transported to the reduction plant the shale should be put through a primary jaw crusher and then sized properly by a hammernmill and deposited in stock piles to be conveyed as required to the distillation unit by conveyor belt. The lay of the land is ideal for this quarry and sizing operation, which presents no difficulties.

A preliminary cost estimate is as follows:

Installation work, mobilization camps, buildings, roads

Development of fuel, water, and power-----	\$290,000
Stripping and quarrying equipment:	
Tractor-----	8,500
Scraper-----	6,500
Ripper-----	4,000
Shovel crane combination-----	40,000
Trucks-----	60,000
Miscellaneous-----	1,000
	120,000
Crushing, sizing, storing, and conveying equipment-----	100,000
Distillation equipment consisting of retorts, condensers, recycle pumps, combustion chambers, tankage, etc-----	400,000
Total-----	820,000
Contingencies-----	80,000
Reserve for alterations and improvements-----	100,000
Total-----	1,000,000

Quarrying and sizing equipment of excess capacity should be initially provided, so that additional retorts could be set up in the line, increasing production without interfering with the operation of the rest of the plant. However, one retort should be installed at a time as experience will possibly change the design somewhat so that additional retorts would be more efficient.

SUPPLEMENTAL STATEMENT OF H. H. CANNON AND E. T. FOLEY

CHARACTERISTICS OF RECOVERED OIL

Variations of flue gas flow rate and of shale throughout can result in marked variation in type of oil produced. This is readily understandable when the partial pressure effect of the flue gas is considered, the larger the quantity of flue gas, the lower the partial pressure—or in other words, the lower the partial pressure, the more nearly the operation approaches that of vacuum distillation.

Oil varying from 10° to 18° gravity, American Petroleum Institute can be produced, the yield, of course, varying directly with the gravity due to the cracking effect taking place when higher gravity yields are obtained.

It should here be stated that oil leached from the shale by suitable solvents has a gravity of about 8° to 10°, American Petroleum Institute.

A typical analysis of the oil follows:

Gravity-----	° A. P. I.	15.3
Sulfur-----	percent	6.3
Viscosity—Universal, at 100°-----	seconds	122
Percentage off, at 400°-----	percent	10.5
Sulfur in gasoline-----	do	5.1
Octane on gasoline-----	do	72

BYPRODUCTS

The spent shale recovered from the retort has been calcined and is free of carbon.

Following is an analysis of a typical sample:

	<i>Percent</i>
Silicon -----	76.40
Alumina -----	11.81
Iron oxide -----	1.29
Calcium oxide -----	.81
Magnesium oxide -----	1.78
Undetermined -----	7.91

VALUE AND USE OF PRODUCTS AND BYPRODUCTS

Gasoline produced from the oil, while of high-octane rating has an excessive sulfur content which must be reduced by blending and/or by one of the sulfur-removal processes. The sulfur may carry through the range of products of distillation and cracking. The residue provides a splendid asphalt. The diatomaceous earth as a byproduct from this process is valuable in small quantities. Heat of calcining can, of course, be controlled so that the structure of the material would not be harmed. It is very useful in light weight aggregate, insulation, etc. It has been determined in the laboratory that the carbon residual in the spent shale before calcining is activated and can be still more highly activated by a simple and inexpensive process. The carbon as seen through a microscope is held in suspension in the diatom structure which allows high and very efficient activation. This is considered highly important by experts in the activated carbon field. A report by Mr. Ray Clinton on this subject has been submitted to Mr. Foley's office. This combination of diatomaceous earth impregnated with activated carbon provides a wonderful filtering, cleaning, and deodorizing medium.

Sulfuric acid, another byproduct, can be very easily reclaimed from the sulfur after it is removed from the gasoline. This appears to be a very valuable byproduct at the present time. Large quantities of this acid are used in industry and also in war products.

Dry ice: Millions of cubic feet of carbon dioxide will be released to the air from this process each day, a portion of which could be compressed into dry ice. The oil-shale property lies in a highly productive agricultural valley, which products need refrigeration for distant shipments. A fishing industry is also under way along the coast towns adjoining the property, which also will have much use for refrigeration. This subject has been investigated and it is found that a good market is available and the commodity can be made inexpensively.

UNIVERSAL OIL PRODUCTS Co.,
Chicago, March 11, 1938.

MR. H. H. CANNON,
Los Angeles, Calif.

DEAR MR. CANNON: We are attaching a laboratory break-up of the two samples of oil furnished by you which were produced from a large deposit of marine diatoms impregnated with heavy oil and which, we understand, were found near Casmalia, Calif.

The oils differ slightly and are, in general, of low gravity and have an exceedingly high sulfur content. In our reports we have refrained from calling the 400 end-point fraction "gasoline," due to its high initial and high sulfur content. However, in spite of its boiling range the octane number is high and in every other respect a satisfactory product, with, of course, the exception of the sulfur content. A satisfactory product, however, probably could be obtained by blending with low sulfur natural gasoline.

Page 2 of our report shows the estimated yields from cracking the residue obtained after topping out the 400 end-point distillate. It will be noted that the yields are rather low, which, of course, can be accounted for by the heaviness of the charging stock.

Our laboratories feel that due to the high-octane number of the straight-run gasoline, it could be treated to a marketable product, although the treat would be heavy and would deteriorate the gasolines appreciably.

With regard to the raw cracked gasoline, it should have an extremely high octane number and would probably finish to a 70-octane product after treatment. However, as you know from previous correspondence and discussions, we would be unable to give you any accurate figures as to the quality of the cracked gasoline unless actual cracking tests were made.

After you have had an opportunity to examine these preliminary results, we would appreciate your comments, or if any questions should arise in your mind please do not hesitate to write us immediately.

Yours very truly,

JOHN B. BARNES.

Laboratory break-up, oils from diatomaceous earth

(By H. H. Cannon)

Sample..... Universal Oil Products Co. sample No.... Fraction.....	Culver City No. 1 28-453 To			Salt Lake No. 2 28-454 To		
	Original	400° F.	Residue	Original	400° F.	Residue
Yield, volume percent of original.....	100.0	27.2	71.4	100.0	10.5	87.2
Properties of fraction:						
Gravity, °A. P. I.....	19.1	39.7	11.9	15.3	43.4	12.4
Specific gravity at 60° F.....	0.9396	0.8265	0.9868	0.9639	0.8090	0.9833
Sulfur (percent).....	6.80	5.71	6.31	6.33	5.12	6.30
Flash, Pensky-Martens, °F.....			220			235
B. S. & W. (percent).....	0.5		0.2	2.3		0.2
Cold test, °F. (below).....	-35		-30	-35		-15
Viscosity, universal, at 100° F. (seconds).....	42		126	122		370
Octane number, M. M.....		74			72	
Characterization factor.....	10.7	11.0	10.63	10.9	11.3	10.9
100 cc. distillation:						
I. B. P., °F.....	232	169	443	268	184	458
5 percent.....	288	226	465	340	238	496
10 percent.....	315	239	482	410	253	532
20 percent.....	371	259	516	515	270	590
30 percent.....	426	274	558	586	282	630
40 percent.....	482	285	595	611	292	656
50 percent.....	544	298	626	656	304	673
60 percent.....	604	311	657	667	315	684
70 percent.....	642	324	676	678	327	693
80 percent.....	710	340	688	709	342	705
90 percent.....	746	360	702	728	360	714
E. P., °F.....	750	401	712	730	400	714
Percent over.....	95.5	98.5	92.0	94.0	99.0	91.0
Percent bottoms.....		1.0			1.0	
Percent coke by weight.....	4.5		7.9	6.5		9.0
Percent loss.....		0.5				
Percent water.....	Trace			1.0		
Percent at 400° F.....	25.5			8.0		
Percent at 572° F.....	54.5		34.0	26.5		16.0

Yield estimate 5037. Estimated yields, oils from diatomaceous earth

(By H. H. Cannon)

Sample..... U. O. P. sample number.....	Culver City No. 1 28-453		Salt Lake No. 2 28-454	
	As received	Dry basis	As received	Dry basis
Fractionation yields, volume:				
Distillate to 400° F. E. P.....	27.2	27.5	10.5	10.7
Residue (cracking stock).....	71.4	72.0	87.2	88.9
Percent water.....	.9		1.9	
Percent recovery.....	99.5	99.5	99.6	99.6
Percent loss.....	.5	.5	.4	.4
Cracking yields, volume percent of residue:				
Cracked gasoline 400° F. E. P.....		29		29
Residuum (Fuel Oil) Grade 6.....		65		66
Recover, percent.....		94		95
Loss, percent.....		6		5
Gas, cubic feet per barrel.....		400		350
Over-all yields, volume percent of dry oil:				
Distillate to 400° F. E. P.....		27.5		10.7
Cracked gasoline.....		20.8		25.8
Total 400° F. E. P.....		48.3		36.5
Residuum (fuel oil).....		46.8		58.6
Recovery.....		95.1		95.1
Loss.....		4.9		4.9
Gas, cubic feet per barrel.....		286		311

STATEMENT OF J. L. GIBSON, PRESIDENT, UTAH CONSERVATION
AND RESEARCH FOUNDATION, AND DEAN EMERITUS, UNIVER-
SITY OF UTAH, SALT LAKE CITY

Mr. GIBSON. My name is J. L. Gibson. Senator Murdock, members of the committee, ladies and gentlemen, it is getting pretty late, and I want to see today if I can take the prize for having the largest report—printed evidence—compared with the amount of words I am going to use to present it, of anyone who has been here today. [Applause.]

(Copy of this report given to each member of the committee.)

Mr. Chairman, I present you with this report of about 900 pages, very much condensed. It contains perhaps the best bibliography on low-temperature carbonization of coal in existence; it gives a summary of the various plans up to the date at which this was printed. It is recent, however. It discusses the various methods of low-temperature carbonization of coal; it makes certain recommendations as to which would be the best processes to be used in the State of Utah for the purpose of making a smokeless fuel. And, in addition to all that, it speaks more or less in detail of the byproducts, including oil.

Now, Mr. Chairman, we might observe this—well, first, I should say that this work extended over a period of between 2 and 3 years; we had a large staff of scientific men working on it, and the work was done in the laboratory of the University of Utah. I should state also the officers, many of them very well trained—gave their services gratis—nearly 3 years of work.

I might say that we have been speaking here today of oil shale, coal, and various other things. I should just like to call your attention to this, in the case of coal: We will not only get the oil and various other products, but when we are through getting them we have smokeless fuel which can be sold for at least the same price as coal. [Applause.]

And the heating value per unit is a little higher than that of ordinary coal. If Salt Lake City had a plant of that kind and it was put to work, and people would use it—which I think they would—this atmosphere here in the wintertime, which is not only disgusting to residents but tends to drive tourists and other people away from this place, would clear up. If I may, I will ask some of our trustees who are present here today if they have anything to add, and then I will close. And I expect to get that prize for having the biggest report, although presented with the fewest words.

Senator MURDOCK. I think right now, Dean Gibson, that you are right on that. I am afraid, however, if you call on people from the audience, you might lose the prize. So, why don't we accept what I think is a very valuable contribution—and that is your report—and I am sure the people that have participated in bringing that about all heartily endorse it and would say "Amen" to everything you have said. The report will be received and made a part of the committee's file.

STATEMENT OF JOHN R. LEWIS, HEAD OF THE DEPARTMENT OF
METALLURGY, AND DIRECTOR, UTAH ENGINEERING STATION,
UNIVERSITY OF UTAH, SALT LAKE CITY, UTAH

Mr. LEWIS. I haven't any new proposition to make especially today, except that I am wondering if this bill is going to provide for syn-

thetic research which may produce hydrocarbons. I am thinking particularly of the method of making hydrocarbons by the Fischer-Tropsch method, along with, of course, the hydrogenation of coal that has already been mentioned. And inasmuch as Dr. Sayers is in the audience, I am going to ask him what is being done with the Fischer-Tropsch method in respect to the making of hydrocarbons by that process.

Senator MURDOCK. Dr. Sayers, will you answer the question, please?

Dr. SAYERS. It is provided for in the bill, and there have been a number of discussions already on the subject. We are doing some work at Pittsburgh with funds that have been provided by Congress. It was mentioned this morning that \$85,000 had been provided by Congress for doing that work, and it is being carried on on a very small scale. It should be larger.

Mr. LEWIS. At the university, while I was connected with the chemistry department, we did some work on this particular problem. Of course, it was purely academic in nature and on a very small scale, but we did actually make hydrocarbons by the combination of hydrogen gas and carbon monoxide. These hydrocarbons can be made, and it seems to me that any program that is initiated by the Government and other agencies should include research work along that line. I thank you.

Senator MURDOCK. Do you have any paper you wish to submit for the record?

Mr. LEWIS. I would like to leave this report.

Senator MURDOCK. This will be included.

(The report referred to by Mr. Lewis is as follows:)

REPORT TO SUBCOMMITTEE ON WAR MINERALS OF THE SENATE COMMITTEE ON PUBLIC LANDS AND SURVEYS, BY JOHN R. LEWIS, HEAD, DEPARTMENT OF METALLURGY, AND ACTING DIRECTOR OF THE UTAH ENGINEERING EXPERIMENT STATION, UNIVERSITY OF UTAH

The purpose of this brief report is to call the attention of the committee to the possibility of preparing motor fuels synthetically from low-cost and abundant raw materials. It is not the writers' contention that synthetic motor fuels will replace natural products at present but rather that they may replace them within a few years.

In Germany, England, Japan, and perhaps other countries, hydrocarbons such as are present in gasoline, kerosene, lubricating oils, and similar products are being made synthetically on a commercial scale. These products have also been prepared on an experimental scale in this country. However, due to our large petroleum reserves, it has been unnecessary for us to go beyond the laboratory stage. So far our interest in producing motor fuels synthetically has been largely academic.

There are two general synthetic methods that have been successfully employed. One is the hydrogenation of coal and the other is the direct chemical combination of carbon monoxide and hydrogen to form hydrocarbons in the motor fuel range.

In the Bergius hydrogenation process, which may be considered as typical of similar processes, coal is powdered and treated with heavy oil or tar to form a paste and the mixture, at a temperature of from 300° to 500° C. is treated with hydrogen at a pressure of 200 atmospheres. From a metric ton (2,205 pounds) of coal about 140 gallons of crude oil may be obtained. From this crude oil, upon distillation, may be obtained about 40 gallons of motor fuel and 50 gallons of Diesel engine oil. Besides this there will be some fuel oil and several thousand cubic feet of fuel gas.

The second process, called the Fischer-Tropsch process, is based on the chemical reactions between hydrogen and carbon monoxide at specified temperatures

and pressures and in the presence of suitable catalysts. Hydrogen may be obtained from water, while carbon monoxide is made by the incomplete combustion of coal or coke. Fortunately both gases can be made simultaneously by passing steam through a bed of burning coke. Any process for the manufacture of fuels making use of these low cost materials should be given serious consideration. Parenthetically it is interesting to point out that these two gases (hydrogen and carbon monoxide) are being used to make methanol which is sometimes called wood alcohol because it was obtained by the distillation of wood. This synthetic alcohol is being prepared on a large scale and is sold at a figure that practically eliminates the production of wood alcohol by the distillation method. Likewise it will not be surprising if the Fischer-Tropsch or similar process is perfected to the point where synthetic fuels can be economically produced in this country.

I believe that any program adopted to insure our supply of motor fuels and similar products should include a research program for the production of fuels synthetically.

Senator MURDOCK. The article from the *Utah Economic and Business Review*, which has been offered here, may be received for the record.

(The article from the *Utah Economic and Business Review* (October 1942) referred to is as follows:)

THE ENERGY RESOURCES OF THE WEST IN RELATION TO THE PATTERN OF WESTERN ECONOMY

(By J. R. Mahoney, director, Bureau of Economic and Business Research¹)

ECONOMIC AND SOCIAL IMPLICATIONS OF ENERGY RESOURCES

Coal, oil, natural gas, and water power are the principal sources from which we have obtained the fuel and the electric energy for the heat, light, and power essential to our industrial civilization. In recent years, the conservation of these great natural resources, their orderly development, their readiness in case of need for the national defense, and the preservation in economic health of the industries that make them available have become matters of national concern. We have realized that the abundance provided for our use by nature will not last forever; we are beginning to realize that the welfare of millions of our people is bound up in these great industries. * * * It is now time to take a larger view; to recognize that each of our great natural resources of energy affects the others. Bituminous coal, petroleum, natural gas, anthracite coal, and water power—in descending order of relative contribution to the Nation's energy supply—these are the energy foundations of our industrial civilization. A policy for any one of these resources is bound to affect its relative position with respect to the others.

The paramount responsibility of government is to protect the general welfare. To protect the general welfare in our time—in an industrialized and urban economy—means, above all else, to build and maintain in good order a sound economic structure. In an industrial civilization the energy resources constitute the foundation of that structure.

It is not likely that backward steps will be taken; it is not likely that we shall retreat from the social and economic advances made in the domain of the energy resources. Rather, it is likely that we shall press on toward the objective of the general welfare.²

In a fundamental sense the machines of our modern economy may be said to be devices through which energy derived from mineral fuels and electricity is converted into useful productive results. The fundamental significance for human welfare of the energy utilized to drive modern machines needs to be clearly visualized so that the proper perspective with regard to its wise use can be maintained. The need for energy in man's economic activity varies from types where costs for fuel and power are of minor significance to those where it may be the dominating element in cost and location.

¹Special appreciation is expressed to Osmond Harline, research assistant of the bureau of economic and business research for assistance in the preparation of this article, and to the university research committee for its publication.

²Energy Resources and National Policy, by National Resources Committee, for 1939, pp. 1-5.

This study has been undertaken to clarify the picture of the relative reserves, rates of depletion, and current practices with regard to the use of the energy resources of the western part of the United States in order that the elements in an economically sound pattern of industry that should logically develop from this basis may be more clearly seen. But more especially the purpose has been to ascertain the extent of reserves and characteristics of the great tri-State coal region of eastern Utah, southwestern Wyoming, and western Colorado, and from this to develop a comprehensive basis for understanding the position this vast storehouse of energy should logically play in the developing industrial economy of the western part of the United States and the Nation as a whole.

Such an appraisal becomes more urgent as the tempo of western industrialization is increased and as the heavy fuel-using industries are expanded to occupy a more prominent part in the industrial pattern of the West. The welfare of millions of people will depend upon a careful adaptation of the unfolding pattern of western economy to the appropriate locations imposed by nature's particular geographical disposition of the energy resources, raw materials, transportation facilities, and other basic factors fundamental to successful economic functioning.

In the eastern part of the United States the pattern of industry has developed largely on a basis determined by the absence of mineral fuels along the Atlantic coast and their abundance in the great hinterland west of the Appalachian Mountains. Some of the coal from the great Appalachian fields can, however, be transported and made available for use along the Atlantic coast at a price that is not excessive. But in spite of this, the heavy fuel-using industries have in the main developed in close proximity to the great inland coal regions of Pennsylvania, West Virginia, Ohio, Indiana, Illinois, and Alabama.

The general pattern of coal distribution in the West is quite similar to that in the East except that the principal coal resources of the western part of the United States are farther away from the Pacific coast. These western coal resources have not as yet been utilized very extensively.

This has resulted from the much less extensive industrialization of the region, the greater distance inland to the coal deposits; but most important, the great flush production of both petroleum and natural gas, especially in California, which by their very cheapness and abundance have invited many industries, some of which are heavy fuel using, to take advantage of the situation. If the reserves of these fuels were of great proportions then such an arrangement would need occasion no concern. But with an impending shortage threatening within a comparatively few years in the face of rapidly mounting utilization, a careful reappraisal of the relation of mineral fuel reserves to the developing pattern of western industry seems to be called for.

The dramatic nature of bonanza discoveries of oil and gas and the super-abundant way these fuels gush forth in the typical initial stages of production creates an impression of abundance that needs periodic reexamination to gain perspective against the less dramatic nature of coal deposits and the more laborious manner of their utilization.

ENERGY RESOURCES OF THE WEST

According to the census of 1940, 10.5 percent of the population of the United States resided in the 11 Western States, but this same area contained approximately 44 percent of all of the bituminous-coal reserves of the United States, together with 18 percent of the natural gas, 24 percent of the petroleum, and 82 percent of the reserves of oil in shale; all of which add up to 46 percent of the reserves of all of the mineral fuels of the country. In addition, the West has 40 percent of the developed hydroelectric power installations and 68 percent of the present and potentially feasible undeveloped capacity of the entire country. All of this indicates that from the point of view of energy resources, the West can develop to several times its present population and still be essentially as well off as other parts of the country, or it may consistently nurture those particular industries making especially heavy demands on mineral fuels.

The West is, however, a very wide and varied geographical area, and in many activities it is not an economic unit. To a significant extent the Rocky Mountains divide the area, leaving part of it facing the Great Plains and the Mississippi Valley. In the region west of the Continental Divide some segments of an integrated pattern of economy is in the process of developing, but many sub-

sections of this vast region have developed an economy largely independent of the rest.

In this extensive western region, while the total energy resources are vast, yet they are very unevenly distributed. In the first place, the great coal resources are confined primarily to the Mountain States with the farthest westward extension in central Utah. The only notable exception to this is the coal in the State of Washington, but here the qualities of the coal and the difficulties met in mining go a considerable distance to reduce the industrial significance of these deposits or make them significant for the contiguous area only. The States of Idaho, Oregon, California, Nevada, and Arizona are either almost or entirely devoid of extensive coal deposits.

While the 11 Western States have 44 percent of the total coal reserves of the country, the great bulk of this is concentrated in eastern Utah, southwestern Wyoming, and western Colorado. This great tri-State coal field accounts for 33 percent of the bituminous-coal reserves of the United States and 60 percent of all of the bituminous reserves of the 11 Western States.

Another significant feature of the energy resources of the West is the high degree of concentration of the oil and gas reserves in California, with smaller fields scattered through the Mountain States, with greatest concentration in Wyoming.

The water-power resources are also unevenly distributed over the West. There are only a few large rivers, but along these the fall in elevation is great so that the developed and undeveloped hydroelectric energy resources of the area are very large. The most favorable situations are along the Columbia River system in the Northwest, the rivers of California, the Colorado River system, and the Missouri River system in Montana. Many of the power sites are in remote areas, but the improvements in long-distance transmission will make much of this power available to industrial centers while the shift of industry to power sites is doing much to insure full utilization of those already developed or projected.

RATE OF DEPLETION OF ENERGY RESOURCES

The Western States use 21 percent more energy per capita than the United States, but there is a marked difference in the pattern of energy use in the West and the country as a whole: Whereas 52 percent of all of the energy utilized in the United States comes from coal, the West derives only 17 percent from this source. On the other hand, the United States draws on petroleum to the extent of 33 percent of its total energy requirements while the West utilizes this fuel to the extent of 56 percent. Natural gas represents 11 percent of the energy for the country as a whole and 16 percent for the Western States. Hydroelectric energy makes up the remaining 11 percent, while in the Nation it is 3.5 percent. This latter heavy use of hydroelectric energy by the West is a very favorable feature of its energy-use pattern, but the great extent to which the industries of the West utilize natural gas and petroleum raises fundamental questions. The ease with which these fuels are produced and their convenience in use are conducive to their overuse. The wisdom of our pattern of use of energy resources depends primarily upon the relative extent of reserves of each and the danger of exhaustion. Of course, this problem does not arise in connection with hydroelectric power and for this reason this source of energy should be utilized as far as practical, but the reserves of all the mineral fuels are definitely limited in amounts. The significance of this becomes evident on examination of the facts depicting the relative extent of the reserves of the several kinds of mineral fuels and the rates of their depletion.

Reference to table IV shows that coal accounts for 98.43 percent of the total energy in the mineral fuel reserves of the Western States, while petroleum represents 0.09 percent and natural gas 0.05 percent. A possible future source of mineral fuel energy in the undeveloped and unutilized oil shale resources of the West represents 1.43 percent.

Table V shows the estimated length of life of the known reserves of the principal mineral fuels for the Western States, for California separately, and for the United States as a whole. This estimated life of the reserves is based on the 1940 production. Some of the elements used for this comparison will, of course, not be very accurately realized. Future consumption of these fuels, especially in the West, is likely to be considerable increased. But offsetting this will be new discoveries both of oil and gas at an unpredictable rate—a rate that may compensate for the increased use for a time or may vary far either way.

In any event the rate of new discoveries must be increased considerably to alter materially the picture of very limited resources in oil and gas.

It will be noted from the table that the reserves of oil are almost the same identical number of times the 1940 production for the West, for California, and for the United States. The estimated years of life of natural gas are 31 for the Western States, 34 for California, and 26 for the United States. The reserves of oil in oil shale are not being drawn on at the present time, but for comparative purposes, if the 1940 consumption of oil in the West and in the United States is used as a basis for calculating the extent of these reserves, they would supply all the oil needs of the West for 253 years and the entire country for 68 years.

The overwhelming extent of the reserves of coal in comparison with current use is also clearly brought out by the table. For the West a life of over 51,000 years for the coal is indicated, or at our present rate of use in the West it would take over 5 centuries to use up 1 percent of the coal reserves. The West could expand its coal consumption to one-half the current coal use for the entire country and use only 1 percent of its reserves in 50 years.

The flush production of both oil and gas in many sections of the United States in the last 40 years has been accompanied by a general condition of over-production, and, until recently, a great wastage of both these resources. The task of the producers has usually been to secure increased consumption to keep the products from being a drug on the market, this in spite of an enormous increase in demand for gasoline and other petroleum products. By the nature of things this is quite certain not to be other than a passing phase of our oil and gas production for it would seem to be quite certain that in the fields of the West the time may be near at hand when the rising tide of consumption would overtake production, and then, beyond this, there would develop progressively an increasing strain on these easily exhaustible energy resources.

The reenactment of the ghost town episode so common to precious metal and some coal mining is not out of the realm of possibility for some industrial populations based on the use of cheap gas and oil during flush production periods. Significant geographical readjustments in the distribution of our industries will rather necessarily take place. This will bring an upward movement of prices for gas and petroleum products and while this would not be an undue strain on those used where fuels form only a minor part of the cost, there would be other uses where any significant price increase would destroy the economic soundness of the established industries depending on cheap fuels.

There are numerous phases of modern economic production where fuel and power play so little a part in the cost of production that such industries are free to be established in areas where fuel and power costs may be high: but there are, however, other segments of industry where the exact opposite is true. The long look into the future is essential largely because of the long life of productive facilities once they are established in an area, and the great disruptive influence on human welfare that may come from a forced readjustment because of exhaustion of natural resources. The location of the steel mills adjacent to the coal fields of central Utah is only one illustration of what appears to be a logical development dictated by the distribution of essential fuel resources of the territory west of the Continental Divide.

In many mining developments, this likely exhaustion of resources is taken into account and discounted, and this needs to be done in planning new industries for any area where fuel supplies are limited. It is necessary to locate mining activities where nature has provided deposits, and the fuel resources are so unevenly distributed that heavy fuel-using industries cannot be foot-loose in choosing a sound location.

This apparent lack of proper perspective in regard to the limited reserves of oil and gas is even more in evidence in the failure to appreciate the enormous quantities of easily mined coal in the tri-State area of eastern Utah, southwestern Wyoming, and western Colorado.

THE QUALITY OF WESTERN COAL

The potential industrial significance of the coals of the western part of the United States has heretofore not generally been clearly visualized. There is abroad an impression that these coals are quite inferior to eastern coals and that they have little industrial significance, which arises partly from this opinion of their quality and partly from their geographical location.

These geologically younger coals are generally low in ash and have a low sulphur content. The moisture content, however, is somewhat higher than is generally the case with the eastern coals and this results in a somewhat lower British thermal unit heat value per pound. This difference is very little for many of the western coals, and the disadvantages these coals may possess in lower heat value is, in many of the fields, more than compensated for by the cheaper mining conditions in the West.

Energy is available at lower costs from western coals than is true in general of coals in other parts of the country. It turns out that instead of industries utilizing western coals having a handicap, they have a distinct advantage in comparison with the energy available in most other parts of the country. It is this more realistic picture of this vast energy storehouse in the bituminous coals of the West that it is the main purpose of this article to present.

The coals of the United States have usually been ranked according to the percentage of fixed carbon and volatile content, beginning with anthracite, with almost all fixed carbon, then semibituminous, high-rank bituminous, then the medium-rank coals, the low-volatile and medium-volatile bituminous, followed by high-volatile bituminous, subbituminous, and lignite. This ranking was supposed also to be indicative of the relative values of these coals from a commercial point of view.

Under the circumstances surrounding the burning of these coals prior to 20 years ago, the larger portion of the volatiles went off into the air unburned to produce smoke and obnoxious gases. The fixed carbon was more easily utilized and the actual heat value of the coal depended mainly on this. Modern coal-burning equipment, however, has changed all this and renders previous classifications more or less obsolete. Coal-burning equipment can be designed and installed to utilize the heat value of the volatiles in the coal as effectively as the fixed carbon. In fact, pound for pound, the volatiles yield a greater number of British thermal units.

It may now safely be said that the chief deleterious features of coal are its moisture, ash, and sulfur contents. For most industrial uses the particular proportion of fixed carbon and volatiles that a coal may contain is essentially a matter of indifference.

For purely domestic use in homes the old classification still holds where modern equipment is not utilized. But appropriate equipment is rapidly coming into use that will burn these higher volatile coals effectively. Since this study has to do primarily with the relationship of coal to industrial development, domestic uses will not be further considered.

In the light of all of these modern developments many of the statements and concepts dealing with the relative values of the coals of the United States must be revised to conform to the changed situation brought about by the improved technology of coal utilization of the last few years.

In earlier times the assumption was widespread that all of the coal west of the one-hundredth meridian was of low quality and of little value. Another early assumption that needs to be revised is that coals of the younger or Cretaceous geological formations in which most western coals occur are necessarily inferior to the coals of the older Carboniferous geological formations in which most eastern coals occur.

The cost per unit of heat or energy released from the burning of the coal is the final significant determining factor in the industrial use of coal. This final cost will be made up of the cost of mining, transportation, and of the preparation of the coal for use in relation to the heat units supplied by the coal.

Mining costs are determined by the physical features of the coal deposits, which include the thickness of the beds, the nature of the floor and the roof, the slope of the bed, the presence or absence of faults, the regularity of the beds, the presence or absence of water, the distance of the working face from the tipple, whether or not shaft mining is necessary, and the depth of the shaft to the coal. These and other possible factors determine the obstacles to be overcome in mining the coal and bringing it to the point of shipment. The accessibility of the coal field to transportation facilities is significant, and, of course, the distance to the market, which may be modified by the grade of the roadbed.

The expense of preparing the coal for utilization is a significant item in some coals, especially those containing rock, bone, or shale and those containing a high percentage of sulfur or ash. In the actual burning of the coal the moisture content is significant in that it subtracts from the available heat value. The presence of sulfur also may render the coal unfit for certain uses, and in other cases is a nuisance.

The older practice of classifying coals on the basis of the proportion of the volatile and fixed carbon contents for most industrial purposes is no longer tenable, since coal-burning equipment can be adjusted to burn any coal effectively, regardless of the relative percentages of the two. Except for special purposes, the British thermal units content is the factor that needs to be most carefully examined and this is determined primarily by the moisture, ash, and sulfur contents. But, in the final analysis, it is not the British thermal units per pound of coal but the heat units available per dollar of cost.

TRI-STATE COAL FIELD

Within the limits of 300 miles eastward from the industrial area along the Wasatch front in Utah 62 percent of all of the bituminous coal of the Western States is located. When the tonnage of lignite coal is included, then the percentage is reduced to approximately 50. Other significant comparisons may be seen by reference to table VII.

In this region of highly concentrated coal deposits there should be ample opportunity to secure as favorable a relationship between the supplies of coal- and fuel-using industries as could be found any place in the world. Some additional idea of the extent of the concentration of coal reserves within this tri-State coal area west of the Continental Divide may be seen when we consider that these reserves are approximately 60 percent greater than all of the coal reserves of Germany, three and one-half times as much as those of France, 85 percent as much as the reserves of all of Europe, and are 10.9 percent of all of the coal reserves of the world.

In the estimates of the coal reserves of the United States as given in Professional Paper 100, by M. R. Campbell, of the United States Geographical Survey, the coal below 3,000 feet is included for some comparisons but for others is excluded. It happens that all of the coal excluded for the United States is within this 300-mile zone and amounts to 60,000,000,000 tons. From the point of view of any realistic consideration of coal that can be economically mined at the present time this deep coal should be excluded, but from the point of view of total reserves it is clear that when more easily mined coal has been exhausted this deeper coal will then be utilized. Since the depth of coal is only one factor in determining the mineability of a particular coal, some of this coal may be utilized before much of that which is present at shallower depths.

The data under "All reserves" in table VII reveals the tremendous concentration of coal within this 300-mile limit eastward from the Wasatch front in Utah. When all coal reserves are considered, over a third of all of the United States reserves and almost 18 percent of the reserves of the world are in this area. This vast reserve of 1,342,216,000,000 tons is approximately one and one-half times all of the coal reserves of Europe. It represents a concentration in this one compact area of approximately four times as much coal as there is in an equal area in the Northern Appalachian field.

Table VIII indicates by a different method the relative degree of concentration of the coal reserves in the tri-State field under consideration and the next region of greatest concentration in the United States, that of the Northern Appalachian field. In each field an area was selected where a circle with a radius of 150 miles could be drawn that would include the greatest quantity of coal. If this point is placed on the Green River about 15 miles east of Vernal, Utah, approximately 617,000,000,000 tons would be included. A similar point chosen at Wetzel County, W. Va., would include approximately 333,000,000,000 tons. If Pittsburgh is used as the center of a similar circle approximately 251,000,000,000 tons would be included. This indicates that the concentration of coal in the Rocky Mountain field is approximately double that of the Appalachian field, but there are an additional 508,000,000,000 tons of coal between 3,000 and 6,000 feet beneath the surface which are not considered mineable under present conditions.

Some reasons for this tremendous amount in so limited an area may be gleaned from the statement that in much of this tri-State field, 20, 30, or 40 different coal seams have been identified. Beds of 16 to 20 feet in thickness are common while in certain areas some may reach 30, 40, and 50 feet. The massive Adaville bed in southwestern Wyoming over a considerable area ranges between 40 and 84 feet, a truly great mass of clean coal unbroken by any significant partings.

These are some of the reasons why this area contains 47.4 percent of all of the bituminous-coal reserves of the United States and 75 percent of the

reserves of the Western States. To have within so small an area approximately 18 percent of all of the coal reserves of the world is truly an outstanding concentration of mineral fuel. But Nature seemed not quite satisfied with this, and so in the period of mountain building, following the coal era, great basins were formed and into these went enormous deposits of shale saturated with approximately 75,000,000,000 barrels of petroleum, an amount approximately 5 times the present estimated oil reserves of the entire United States.

Following the long period of coal formation a geological revolution resulted in an uplifting of the area with extensive mountain building, but also intensive mineralization of the region immediately west of the coal area. The result is that the most extensively mineralized area of the United States joins and to some extent is intertwined with the western fringe of this tri-State coal field containing the greatest concentration of mineral fuels in the world. Since many of these minerals require great quantities of fuel and power for their processing for human use, the close geological proximity of these minerals and fuels is one of the most fortunate of all of the gifts of nature to man.

The tremendous reserves of coal in this tri-State field are easily available for the industrialized region along the Wasatch front. Coals from the southern portion of the area move over the Denver & Rio Grande and Utah Coal Route railroad lines to be distributed along the Wasatch front and beyond. The lines of the Union Pacific Railroad cut through the heart of the northern portion of the field making any coal along that line easily available for any industrial need. Coal from the central part of this tri-State coal area does not now move into the region. In case of a large industrial need it could be made available by the extension of the Denver and Salt Lake Railroad from Craig, Colo., through the Uintah Basin to connections with other railroads and move into the area through Provo and Weber Canyons.

Ample opportunity exists for heavy fuel-using industries to establish themselves in the heart of the coal fields where economic advantages could be secured through reduction of freight rates. This would be especially advantageous where bulk mineral raw materials requiring large quantities of fuel or power are also present in the coal region. A series of steam-power generating stations could be built close to the coal deposits for the purpose of providing the area with the cheap and abundant electrical energy so necessary to the development of a number of new mineral refining and fabricating industries and the further processing of some of the products already being abundantly produced in the area.

Great hydroelectric power projects have recently been so much in the public eye that the relative importance of this source of energy is likely to be exaggerated. In 1940, hydroelectric energy amounted to only 3.5 percent of the total energy used in the country, while for the Western States it was 10.8 percent. Great improvements in the efficiency of the generation of electricity in steam plants is increasing the economy of this source of electrical energy. It requires less than half the amount of coal to generate a given amount of electricity now than it did 20 years ago.

The accompanying table gives the average number of pounds of coal required to generate 1 kilowatt-hour of electricity for all of the central power stations of the United States for selected years from 1902 down to 1940. The general movement toward greater fuel economy in steam-power generation is fairly well presented by this table, but these averages are made up of the performance of many small and old plants and thus conceals the fact that the larger modern plants have fuel efficiencies far in excess of the figures given. Large plants with modern equipment can now produce a kilowatt-hour of electricity with approximately eight-tenths of a pound of coal.

Pounds of coal consumed per kilowatt-hour of electricity generated

[Average, United States, central power stations]

Year	Pounds of coal	Year	Pounds of coal	Year	Pounds of coal
1902.....	6.6	1920.....	3.04	1932.....	1.50
1907.....	5.4	1923.....	2.41	1935.....	1.46
1913.....	4.5	1926.....	1.95	1938.....	1.41
1917.....	3.5	1929.....	1.69	1940.....	1.37

This increased efficiency has resulted largely from marked increases in the pressure and temperature achieved in modern steam plants made possible by a great increase in the strength of the materials used in their construction. This has made it possible to move from pressures of 300 and 500 pounds per square inch to those of 1,500 and 2,500 pounds, along with marked increases in temperatures. These changes along with great improvements in fuel-burning equipment and design of plants have not only resulted in greater fuel economy but also important savings in capital outlay per unit of capacity. The capital costs of modern steam plants are far less than hydroelectric plants of similar capacity. This, together with the factor of generally more convenient location, is an offset against fuel costs for the steam plants.

It is significant that over the last 20 years with only a very few exceptions, private enterprise has installed steam power plants rather than hydroelectric plants. Expansion in hydroelectric facilities has had to depend almost entirely upon Government financing, and this usually in connection with multiple-purpose programs ordinarily involving flood control, navigation, and sometimes water storage for irrigation. Utah and adjacent areas may yet receive significant amounts of hydroelectric power through the completion of projected dams on the upper Colorado River system and this would be of great industrial significance. Aside from this possibility, this section of the western region has an almost ideal set of circumstances for the generation of any amount of steam power that will be needed for any industrial power that will be needed for any industrial purpose for which cheap and abundant power is essential.

On the basis of modern steam plant installations, figuring 1 pound of coal per kilowatt-hour, the amount of coal that will be utilized to produce the coke for the blast furnaces in the Provo area would generate an amount of electricity equal to the total production of all the hydroelectric plants of California in 1940. It would be equal to twice the amount of firm energy available at Boulder Dam in the same year, and approximately equal to the total amount of energy that will be available for strictly industrial purposes from either Boulder Dam or Grand Coulee in their ultimate developments.

Steam-electric plants producing electric energy for industrial purposes, some of which might be located back in the great tri-State coal fields, could give this area all of the low-cost electric power needed for refining, metallurgical, and chemical plants for a complete development of the extensive mineral resources of the area. This could be very cheap electricity and could be developed on any scale adequate to meet any needs and still be an almost infinitesimal draft on the vast coal resources of the area. Cheap and abundant electrical energy is the region's most important missing ingredient for that type of industrialization that is economically justifiable from so many other points of view. The fortunate situation exists, however, that the region can have all the cheap power needed for all purposes and be in complete harmony with sound national policy.

ELECTRIC POWER NEEDS IN MINERAL PROCESSING

The processing and refining of mineral products, both metallic and nonmetallic, utilize the largest block of electricity in modern industry. In the processing of some minerals, the use of electricity is the only method that is feasible; in others, it is the most effective method; while in still others its use depends upon its cost relative to alternative fuels or processes. Some of the more important segments of mineral production in which electric power is heavily utilized are listed in table IX. The first column gives the product, the second column the raw materials together with other materials that are essential in the process, while the third column shows the number of kilowatt-hours required at typical installations to produce a unit of the product as indicated in the fourth column.

Raw materials for virtually all of the products listed in the table can be found in rather close proximity to the great tri-State coal field we have described in this article. Some of these are already being produced in the area and their further processing may very well be a part of our industrial picture of the future. Most of those in the list are such heavy consumers of electricity as to make cheap and abundant power a necessity. Almost an ideal set of circumstances exists for this cheap and abundant production of steam-generated power and it can be maintained with confidence that no region of the world dependent upon steam-generated power could be more favorably situated. The presence of the raw materials for these products in close proximity to the sources of heat

and power brings the development of most of them within the realm of possibility in the future.

We have in our research work already accumulated many of the basic facts necessary to judge the feasibility of developing most of the industries listed in the table. It is a part of the plan of the Bureau of Economic and Business Research to complete these studies and publish them, but at this point we may indulge in a few statements of the economic features of a few of the products listed in the table since they are closely related to the energy resources of this region.

For the first time alumina will be available in Utah when the present plant now in the course of construction in south Salt Lake is put into operation. Present plans call for the shipment of alumina made in this plant from the alunite ores of the Marysvale district to sources of cheap power out of the State where it will be reduced to metallic aluminum.

Questions of the economic soundness from a broad national point of view may well be raised of the present practice of shipping tremendous quantities of blister copper from Utah to the Atlantic coast where it is refined by electricity produced from coal mined in West Virginia and western Pennsylvania, and then shipping the refined copper to consuming centers in the United States.

The establishment of an electrolytic refinery for zinc has long been one of the great industrial needs of this area. The present practice of shipping large quantities of zinc concentrates considerable distances out of the State reflects itself in less profit for the ore mined and a limitation on the deposits capable of being mined.

The raw materials for the production of metallic magnesium have not hitherto been produced in the area, but if the exploration of the salt deposits in the vicinity of Thompson in eastern Utah demonstrates the presence of mineable magnesium chloride, then the situation will be definitely changed and the problem of its refinement would then be in need of solution. Since these deposits are within a few miles of possible large hydroelectric developments on the Green and Colorado Rivers, and are virtually in the heart of the coal fields, cheap electricity should be readily available for the production of metallic magnesium in any amounts consistent with the underlying economic facts.

The production of alloy steels in connection with the expanding iron and steel development in Utah introduces many other possibilities of need for large quantities of electricity. Modern steel production runs heavily to alloy steels. In the last 2 years, the installations for the production of electric furnace steel have been more than doubled. In January 1940 electric steel capacity was 160,000 tons per month while in July 1942 it was 360,000 tons, approximately 5 percent of total steel capacity.

Aside from this growing need of electricity for steel production itself, there is a tremendous present-day use of electricity in the production of ferroalloys, the raw materials for most of which are plentiful in this region. The raw materials for production of ferrosilicon, unlike most of the other types, are plentiful in most regions. This is the most heavily used of the ferroalloys in the steel industry, being used mainly as a deoxidizing agent. Its production here will be determined by the need for it in the local steel industry. The price of electricity is the principal element in its cost.

The raw materials for the production of ferromanganese, the next ferroalloy in order of tonnage, will be available for the satisfaction of the local needs in the steel industry if present efforts are successful to make concentrates from our low-grade western manganese deposits. The further possibility of sufficient supplies of both tungsten and vanadium for these important ferroalloys appears probable on the basis of present local production and additional recent discoveries. The abundance of molybdenum from the vast deposit at Climax, Colo., and from the byproduct production at the Utah Copper operations makes the local production of this important ferroalloy feasible.

The proximity of the raw materials for all of these ferroalloys to this developing steel center may constitute a significant advantage over the steel industry in the other parts of the country and it will probably loom large in establishing its basic soundness and also in determining the strategic location of the finished steel production for the western region.

The production of synthetic ammonia by utilizing the process of blowing steam over coke to produce hydrogen, which is then united with the nitrogen from the air, is the present chief source of our nitrate products for fertilizers, explosives, and other products of nitrogen. Cheaply mined coal is the most

basic economic need for this production. Where cheap electricity is available, the hydrogen may be secured from the electrolysis of water. From ammonia a whole string of nitrogen products can be produced.

The most effective way of producing concentrated phosphate products is by using the electric furnace to liberate the phosphorus from the rock. Northern Utah, southeastern Idaho, western Wyoming, and Montana have approximately two-thirds of all the phosphate deposits of the world, but the effective utilization of these vast deposits will depend largely on the production of phosphate products in a concentrated form. Phosphoric acid produced by the electric furnace, if combined with ammonia from the byproduct coking of our coals, or from the synthetic ammonia process, would produce a double fertilizer of almost 100 percent concentration.

All that would need to be added for an ideal set of circumstances for the effective production of highly concentrated mixed fertilizers would be the availability of potash. The production of magnesium chloride from the Thompson deposits is the most significant feature of that projected development but potash would be available as a byproduct. The alunite processing will have a potash byproduct as will projects carried on at Salduro, and possibly in the future potash may be recovered from the salts of the Great Salt Lake. These developments open the possibility of these three basic fertilizer raw materials—phosphates, potash, and nitrates—being available in such close proximity to each other as to constitute one of the most dynamic features of the future industrialization of this region.

COAL AS A RAW MATERIAL OF THE CHEMICAL INDUSTRY

From the point of view of tonnage, coal is the most important raw material of the chemical industry. The number of chemical products that are derived from coal tars and refinery gases runs into the thousands. The tremendous increase in the byproduct coking of coal in Utah in connection with the new steel development will furnish large quantities of these raw materials for a diversified chemical industry. The source of these byproducts is the volatile matter in the coal. Since western coals have a higher volatile content than the coking coals of other sections of the United States, the proportion of these byproducts to coke output will furnish that much more of a basis for the production of chemicals and many other products. It is the high percentage of these volatiles in western coals that is both the basis for the aggravated smoke nuisance in this region, and the opportunity for the development of a wide variety of chemical industries based on the utilization of these valuable coal tars and gases.

It should also be noted that when our oil and natural gas supplies are nearer depletion we will turn to coal as a source of oil, gas, and gasoline. It is in western coals that the Nation has its greatest reserve supply of these products. Every approach toward depletion of oil and gas will increase the relative economic position of areas with abundant supplies of coal. The tremendous coal reserves in the tri-State field of eastern Utah, western Colorado, and southwestern Wyoming should progressively assume a more and more important position in the economic life of not only the West but of the Nation as a whole. It is here that the establishment of heavy fuel-using industries can have their greatest justification and the abundant mineral raw materials of the region are generally of the type requiring large quantities of fuel and power. To ship these heavy fuel-using products from this region to make use of mineral fuels in other areas less well supplied needs careful reexamination.

SUMMARY AND CONCLUSIONS

The primary purpose of this article has been to ascertain the extent of the reserves, rate of depletion, and geographical distribution of the energy resources of the West, and from this to throw light on the pattern of industry that should logically develop therefrom. Careful examination of these resources reveals that the West, meaning the 11 western States, has reserves of all mineral fuels far in excess of its needs based on proportionate population, and is even more fortunate in developed and undeveloped water power.

In spite of this fortunate position in total reserves of energy resources for the West, the various types are very unevenly distributed. The main concentrations of petroleum and natural gas are in California and in the area east of the Continental Divide. The coal reserves have a concentration of almost the same degree, but they are confined mainly to the Rocky Mountain States, with greatest concentration in Wyoming, Colorado, Utah, and Montana. Poten-

tial hydroelectric power, while more widely dispersed than the mineral fuels, is heavily concentrated in the Northwest along the Columbia River system, with less important sites in the mountain area of California and along the Colorado and Missouri River systems.

The most striking features of the reserves of mineral fuels are the overwhelming concentration in coal and the meager amounts by comparison in natural gas and petroleum. The coal reserves represent 1,000 times the energy values of the petroleum reserves, and 2,000 times that of the natural-gas reserves. In the face of these vast differences in reserves, petroleum supplies $3\frac{1}{2}$ times as much energy as coal, and natural gas provides an amount equal to that of coal. This in spite of the fact that on the basis of current rates of use the reserves of natural gas and petroleum are measured in decades, while for coal the unit would have to be in tens of thousands of years.

Perhaps the most significant feature of the study has been the portrayal of the vast concentration of energy resources in the tri-State coal field of southwestern Wyoming, western Colorado, and eastern Utah. This is believed to be the greatest concentration of energy resources in the world. It represents a concentration approximately double that of the northern Appalachian coal field—when coal below 3,000 feet in depth is excluded. If all coal reserves are included then the total tonnage within 300 miles of the Wasatch Front in central Utah represents 63.9 percent of all the reserves of the West, 47.4 percent of the bituminous and subbituminous reserves of the United States, 35.5 percent of all coal reserves of the United States, and 17.8 percent of all the coal reserves of the world.

What part this vast storehouse of energy should play in the energy-use pattern of the West and the United States merits the most careful consideration. The strategy of the location of heavy fuel-using industries in the West is especially important. A very large proportion of the mineral resources, both metallic and nonmetallic, of the United States are concentrated in the West. Most of these minerals require large amounts of fuel and power in their processing. It would seem to be especially important in planning the economy of the West, therefore, that the greatest care should be exercised in locating industries based on these heavy fuel- and power-consuming minerals with special reference to the vast coal reserves and the sites of abundant hydroelectric power.

TABLE I.—*Energy resources of the west compared with those of the United States*

Coal (tons)	Western States		Remainder of the United States	
	Amount	Percent	Amount	Percent
Coal (tons):				
Anthracite.....	91,471,000	0.6	15,324,131,000	99.4
Bituminous.....	364,265,943,000	25.9	1,043,542,348,000	74.1
Subbituminous.....	818,083,894,000	100.0		
Lignite.....	315,473,543,000	33.6	623,983,900,000	66.4
Total coal (above 3,000 feet).....	1,497,914,851,000	47.1	1,682,850,379,000	52.9
Coal (tons, 3,000 to 6,000 feet in depth).....	604,000,000,000	100.0		
Grand total, all coal.....	2,101,914,851,000	55.5	1,682,850,379,000	44.5
Bituminous coal equivalent (coal above 3,000 feet only).....	1,085,929,533,000	44.3	1,362,917,044,000	55.7
Bituminous coal equivalent of all coal.....	1,603,958,730,000	54.1	1,362,917,044,000	45.9
Petroleum (barrels).....	4,586,000,000	23.9	14,625,000,000	76.1
Natural gas (cubic feet).....	15,553,000,000,000	18.3	69,447,000,000,000	81.7
Oil in shale (barrels).....	75,000,000,000	81.5	17,000,000,000	18.5
Electricity (kilowatt-hour annual capacity):				
Production 1940.....	20,882,000,000	39.7	31,749,000,000	60.3
Estimated feasible additional output ¹	181,584,000,000	71.5	72,379,000,000	28.5
Total feasible annual output ²	218,364,000,000	67.8	103,593,000,000	32.2

¹ From the National Resources Planning Board's estimate of 1937 has been deducted the ultimate capacity of Bonneville and Grand Coulee.

² 1937 production plus estimated additional output.

Source: Coal reserves, oil in shale, Energy Resources and National Policy, National Resources Committee. Petroleum reserves, Minerals Yearbook, Review of 1940; and department of natural resources, State of California. Natural gas, Gas Age, May 8, 1941; and department of natural resources, State of California.

TABLE II.—*Relative concentration of reserves of energy resources in the Western States*

Type and location of energy resource	Amount	Percent distribution
Coal:	<i>Thous. of tons</i>	
Western States	1, 497, 914, 851	100. 0
Tri-State coal field	717, 372, 512	47. 9
Balance of coal in Utah, Wyoming, and Colorado	312, 824, 451	20. 9
Total, Utah, Wyoming, and Colorado	1, 030, 196, 963	68. 8
Montana	380, 932, 321	25. 4
Washington	63, 666, 671	4. 3
Other States (Arizona, California, Idaho, Oregon, and New Mexico)	23, 118, 896	1. 5
Petroleum:		
Western States	4, 586, 000, 000	100. 0
California	3, 477, 000, 000	75. 8
Other States (Montana, Wyoming, Colorado, and New Mexico)	1, 109, 000, 000	24. 2
Oil in shale:	<i>Barrels</i>	
Western States (Utah, Colorado, and Wyoming)	75, 000, 000, 000	100. 0
Natural gas:	<i>Thous. of cubic feet</i>	
Western States	15, 553, 000, 000	100. 0
California	12, 853, 000, 000	82. 6
Other States (Montana, Wyoming, Colorado, New Mexico, Utah, and Washington)	2, 700, 000, 000	17. 4
Hydroelectric power:¹	<i>Annual production, thous. of kw.-hrs.</i>	
Western States	218, 364, 000	100. 0
Washington	76, 104, 000	34. 8
California	43, 358, 000	19. 9
Oregon	35, 633, 000	16. 3
Idaho and Montana	32, 473, 000	14. 9
Arizona and Nevada	16, 445, 000	7. 5
Other States (Wyoming, Colorado, New Mexico, and Utah)	14, 351, 000	6. 6

¹ Present annual production plus potential feasible capacity.

TABLE III.—*Production of energy in Western States, 1940*

State	Coal		Petroleum		Natural gas		Hydro electricity		Total energy produced by each State		Total reserves of mineral fuels in each State ¹	
	Net tons	B. t. u., trillions	Thousands of barrels	B. t. u., trillions	Millions of cubic feet	B. t. u., trillions	Thousands of kilowatt-hours	Prevailing fuel equivalent B. t. u., trillions	Trillions of B. t. u.'s contributed by each State	Percent of total energy contributed by each State	Trillions of B. t. u.'s of mineral fuel reserves, in each State	Percent of total mineral fuel reserves, in each State
California	1,081,000	27.03	223,881	1,343.29	351,950	378.35	8,770,607	114.72	1,866	59.28	36,816	0.12
New Mexico	5,748,000	138.82	29,001	234.01	63,990	68.79	1,561	.03	530	10.48	576,480	1.84
Wyoming	6,748,000	162.90	25,683	164.10	27,346	29.40	96,035	1.59	324	10.29	12,560,831	40.04
Colorado	6,816,000	162.90	1,350	8.10	2,533	2.72	218,484	3.61	177	5.62	8,258,804	26.32
Montana	2,974,000	59.48	6,768	40.61	26,231	28.20	1,736,761	28.66	157	4.99	5,698,818	18.16
Utah	3,824,000	91.62	—	—	4,301	4.62	2,641,673	4.20	100	3.18	2,835,015	9.04
Washington	1,688,000	32.82	—	—	39	.04	3,661,126	60.41	99	3.14	1,353,188	4.31
Nevada	—	—	—	—	—	—	2,306,804	38.07	38	1.21	—	.04
Oregon	—	—	—	—	—	—	1,343,294	22.17	22	.70	11,898	.06
Idaho	—	—	—	—	—	—	1,175,242	19.39	19	.60	19,213	.06
Arizona	—	—	—	—	—	—	980,934	16.19	16	.51	22,935	.07
Total	21,531,000	518.67	296,683	1,780.11	476,390	512.12	20,545,521	339.04	3,148	100.00	31,374,058	100.00

Percent of total energy contributed by each type of fuel:

Western States.....

United States.....

¹ Includes reserves of coal, petroleum, natural gas, and oil in shale only. Hydro electricity being inexhaustible is not comparable with reserves of the mineral fuels.

Source: Minerals Yearbook—Review of 1940 for coal, petroleum and natural gas; Federal Power Commission's monthly report for hydroelectric production. Values used in arriving at B. t. u.'s were: Coal—Montana, 10,000 B. t. u. per pound; Colorado, 12,500; New Mexico, 12,500; Utah, 13,000; Wyoming, 12,000; Washington, 11,500. Petroleum—6,000,000 B. t. u. per barrel. Natural gas—1,075 B. t. u. per cubic foot. Hydro electricity—prevailing fuel equivalent 1.37 pounds of coal per kilowatt-hour.

TABLE IV.—*Reserves of mineral fuels and their importance in terms of heat value*

[11 Western States]

	Proven reserves (in thousands)	B. t. u.'s per unit	Trillions of B. t. u.'s	Percent
Coal (tons):				
Anthracite.....	91, 471	12,700 per pound.....	2, 323	0. 01
Bituminous.....	364, 265, 943	13,000 per pound.....	9, 470, 915	30. 19
Subbituminous.....	818, 083, 894	10,500 per pound.....	17, 179, 762	54. 76
Lignite.....	315, 473, 543	6,700 per pound.....	4, 226, 823	13. 48
Total.....	1, 497, 914, 851		30, 879, 823	98. 43
Petroleum (barrels).....	4, 586, 000	6,000,000 per barrel.....	27, 516	. 09
Natural gas (cubic feet).....	15, 553, 000, 000	1,075 cubic feet.....	16, 719	. 05
Oil in shale (barrels).....	75, 000, 000	6,000,000 per barrel.....	450, 000	1. 43
			31, 374, 058	100. 00

Source: Coal reserves and oil shale reserves, Energy Resources and National Policy, National Resources Committee. Petroleum reserves, Minerals Yearbook, Review of 1940; and Department of Natural Resources, State of California. Natural gas, Gas Age, May 8, 1941; and Department of Natural Resources, State of California.

TABLE V.—*Estimated length of life of reserves assuming utilization at the same rate as for 1940*

	Petroleum, in thousands of barrels	Natural gas, millions of cubic feet	Coal, thou- sands of tons	Oil in shale, thousands of barrels
Western States:				
Reserves.....	4, 568, 000	15, 553, 000	1, 497, 914, 851	75, 000, 000
1940 consumption.....	296, 683	509, 690	29, 002	296, 683
Life in years.....	15. 5	30. 7	51, 648	253
California:				
Reserves.....	3, 477, 000	12, 853, 000	39, 948	---
1940 consumption.....	223, 881	382, 090	---	---
Life in years.....	15. 5	33. 6	---	---
United States:				
Reserves.....	19, 211, 000	85, 000, 000	3, 180, 765, 230	92, 000, 000
1940 consumption.....	1, 351, 847	3, 309, 328	610, 521	1, 351, 847
Life in years.....	14. 2	25. 7	5, 221	(¹)

¹ On the assumption that all of the oil consumption would be drawn from oil shale at the 1940 rate.

Sources: Coal reserves and oil in shale, Energy Resources and National Policy. Petroleum reserves, Minerals Yearbook, Review of 1940; and Department of Natural Resources, State of California. Natural gas reserves, Gas Age, May 8, 1941, estimate of R. E. Davis; and Department of Natural Resources, State of California.

TABLE VI.—*Typical analyses of coals of the Tri-State coal field together with averages of typical analyses of eastern coals*

State and county	Moisture content	Volatile matter	Fixed carbon	Asb	Sulfur	Calorific value, B. t. u.'s per pound
Utah:						
Carbon.....	4. 9	41. 9	47. 1	6. 1	0. 5	12, 860
Carbon (Sunnyside).....	4. 1	37. 9	51. 7	6. 3	. 7	13, 220
Emery.....	4. 6	41. 2	47. 6	6. 6	. 7	12, 850
Summit.....	14. 6	37. 4	43. 6	4. 4	1. 2	10, 710
Duchesne.....	16. 3	35. 9	42. 4	5. 4	. 7	10, 400
Uintah.....	9. 2	36. 3	48. 2	6. 3	. 8	11, 850
Wyoming:						
Sweetwater.....	12. 7	36. 2	47. 2	3. 9	. 8	11, 750
Lincoln (bituminous).....	5. 6	38. 4	49. 8	6. 2	. 8	12, 650
Lincoln (subbituminous).....	21. 1	35. 2	40. 5	3. 2	. 7	10, 040
Carbon.....	12. 8	37. 1	43. 5	6. 6	. 5	11, 010
Uintah.....	17. 6	33. 5	43. 1	5. 8	. 7	10, 290
Colorado:						
Routt.....	11. 9	35. 2	48. 4	4. 5	. 6	11, 510
Gunnison (high rank).....	3. 5	8. 4	80. 2	7. 9	1. 0	13, 660
Gunnison (low rank).....	7. 0	36. 7	51. 3	5. 0	. 6	12, 800
Mesa.....	8. 0	36. 2	47. 8	8. 0	1. 1	12, 110
Delta.....	14. 6	33. 4	43. 4	6. 6	. 5	10, 830

TABLE VI.—*Typical analyses of coals of the Tri-State coal field together with averages of typical analyses of eastern coals—Continued*

State and county	Moisture content	Volatile matter	Fixed carbon	Ash	Sulfur	Calorific value, B. t. u.'s per pound
Colorado—Continued						
Rio Blanco.....	14.3	32.8	47.4	5.5	0.9	10,830
Moffat.....	16.1	34.0	45.5	4.4	.8	10,370
Jackson.....	20.4	32.1	42.1	5.4	.4	9,800
La Plata.....	4.1	36.9	50.8	8.2	.7	13,120
Pennsylvania:						
High volatile.....	3.0	34.2	54.1	8.7	1.8	13,400
Low and medium volatile.....	2.9	20.6	66.6	9.9	1.7	13,566
West Virginia:						
High volatile.....	3.2	34.4	56.4	6.0	.9	13,846
Low and medium volatile.....	2.6	20.0	71.9	5.5	.9	14,396
Alabama.....	3.1	32.6	56.2	8.1	1.2	13,481
Indiana.....	11.7	36.4	42.7	9.2	2.8	11,461
Illinois.....	12.3	34.9	42.3	10.5	3.3	11,042

Source: Typical Analysis of Coals of the United States, Bureau of Mines Bulletin No. 446, 1942. Analyses of coals for Alabama, Indiana, and Illinois are the averages of all analyses given. For Pennsylvania and West Virginia, averages are for principal producing counties.

TABLE VII.—*Estimates of coal reserves within 100-, 200-, and 300-mile radius of the Wasatch front in Utah*

Distance	Thousands of tons	Percent of western bituminous and sub-bituminous reserves	Percent of total western coal reserves	Percent of United States bituminous and sub-bituminous reserves	Percent of total reserves of the world	Percent of total United States reserves
Reserves above 3,000 feet:						
100 miles.....	129,353,000	10.9	8.6	5.8	1.9	4.1
200 miles.....	581,905,000	49.2	38.8	26.2	8.6	18.3
300 miles.....	738,216,000	62.4	49.3	33.2	10.9	23.2
All reserves:						
100 miles.....	221,020,000	12.4	10.5	7.8	2.9	5.8
200 miles.....	1,076,856,000	60.3	51.2	38.1	14.2	28.4
300 miles.....	1,342,216,000	75.1	63.9	47.4	17.8	35.5

See Energy Resources and National Policy, National Resources Committee; and Coal Fields of the United States, U. S. Geological Survey Professional Paper 100, M. R. Campbell, p. 24.

Wasatch front is designated as the area fronting the Wasatch Mountain Range in Wever, Davis, Salt Lake, and Utah Counties in Utah.

TABLE VIII.—*Relative concentration of coal in Rocky Mountain and Appalachian coal fields*

	Estimated tonnage in thousands of tons	Percent of bituminous and sub-bituminous	Percent of total United States reserves	Percent of world reserves
Rocky Mountain field:				
150-mile radius of point on Green River in Utah.....	616,957,720	27.3	19.4	9.1
Same area but including reserves between 3,000 and 6,000 feet.....	1,124,872,720	39.8	29.7	14.9
Appalachian field:				
150-mile radius of point in Wetzel County, W. Va.....	382,672,177	14.9	10.5	4.9
150-mile radius of Pittsburgh.....	250,743,190	11.3	7.9	3.7

See Energy Resources and National Policy, National Resources Committee; and Coal Fields of the United States, U. S. Geological Survey Professional Paper 100, M. R. Campbell, p. 24.

TABLE IX.—Unit requirements for electric energy

Product	Raw materials	Average consumption of electric energy kilowatt-hours (electrolytic or electro-thermal)	Unit
Aluminum.....	Alumina from hauxite and alunite.....	21, 021	Per short ton (2,000 pounds).
Copper.....	Blister copper.....	249	Do.
Zinc.....	Zinc concentrates.....	3, 381	Do.
Cadmium.....	Zinc dust purification residues.....	2, 048	Do.
Magnesium.....	Magnesium chloride or oxide, carnalite, or dolomite.....	16, 000-20, 000	Do.
Chloride and caustic soda.....	Common salt.....	3, 000	Per short ton of chlorine.
Cast and alloy iron: Duplex.....	Open-hearth steel or scrap.....	50-115	Per short ton of metal melted.
Batch-cold melt.....	do.....	500-600	Do.
Steel ingots: Duplex.....	do.....	100-200	Per long ton (2,240 pounds).
Batch-cold melt-tool and special alloys.....	do.....	500-750	Do.
Stainless and automotive.....	do.....	525-650	Do.
Straight carbon.....	do.....	500-550	Do.
Cast steel: Duplex.....	do.....	75, 150	Per short ton of metal melted.
Batch-cold melt.....	do.....	500, 700	Do.
Ferrosilicon, 15 percent silicon.....	Iron, silicon, and coke.....	4, 000-5, 000	Per short ton (2,000 pounds).
Ferrosilicon, 50 percent silicon.....	do.....	5, 000-6, 000	Do.
Ferrosilicon, 70 percent silicon.....	do.....	6, 000-6, 500	Do.
Ferromanganese, 80 percent manganese.....	Coke, iron ore, or steel scrap.....	6, 000-7, 000	Do.
Silicomanganese, 70 percent manganese.....	Manganese ore, silica, iron, and * coke.....	4, 500-6, 500	Do.
Ferrochromium, 70 percent chromium.....	Chromite, coke, iron, or iron ore.....	6, 000-8, 000	Do.
Ferrotungsten, 70-75 percent tungsten: Smelting.....	Tungsten ore, iron or iron ore, coke and silica.....		
Refining.....		4, 200	Do.
Total.....		3, 400	Do.
Ferromolybdenum, 75 percent molybdenum.....	Molybdenite, iron, coke, and calcium oxide.....	7, 600	Do.
Ferrovanadium, 35-40 percent vanadium.....	Vanadium ore, coke, iron, and ferrosilicon.....	8, 000-9, 000	Do.
Brass.....	Copper and zinc.....	4, 500-8, 000	Do.
Bronze.....	Copper and tin.....	252	Per short ton of metal melted.
Artificial abrasives: Silicon carbide.....		285	Do.
Fused alumina.....	Coke, silica sand, and sawdust.....	8, 495	Do.
Calcium Carbide.....	Bauxite, coke, and scrap iron.....	2, 809	Do.
Graphitized products.....	Coke and lime.....	3, 000	Do.
Nitrogen-existing synthetic ammonia plants in United States at capacity operation.....	Low ash coals, or petroleum coke.....	3, 000-8, 000	Do.
Nitrogen-synthetic ammonia using electrolytic hydrogen.....	Hydrogen from steam blown over live coke and nitrogen from the atmosphere.....	1, 530	Per short ton of contained nitrogen.
	Hydrogen from the electrolysis of water and nitrogen from the atmosphere.....	15, 000	Do.
Phosphoric acid (electric furnace).....	Phosphate rock, silica, and coke.....	4, 500-5, 500	Per short ton of contained P ₂ O ₅ .

Source: Power Requirements in Electrochemical Electrometallurgical and Allied Industries, Federal Power Commission, 1938; and Industrial Electro-Chemistry, by C. L. Mantell, McGraw-Hill Book Co.

Senator MURDOCK. Please give your name to the reporter, Mr. Storrs. Will you be good enough to summarize your paper and leave the entire statement for the record? Thank you.

Mr. STORRS. My name is K. L. Storrs. I am president and general manager of the Coal Logs Co., Salt Lake City. I have prepared a statement which it too long to read in its entirety, but I will leave it

for the record, as you request. I am also submitting a report by Mr. George W. Carter.

Senator MURDOCK. All right.

Mr. STORRS. This offers a complete answer to the problems now confronting the committee at this time. We ask only your thorough investigation of what we offer, and we wish to assure the committee and all present that we are open to thorough investigation by all those who are interested. I thank you very much.

Senator MURDOCK. I want to say this, for the record, that I have had a lot of contact with Mr. Storrs and Mr. Carter in the very splendid work they are doing right in line with what the bill proposes. I cannot commend them too highly for the splendid work they have done. I hope, before we get through, Mr. Storrs, your plant will be built.

Mr. STORRS. Thank you, sir.

Senator MURDOCK. I understand you have offered these papers now for the record.

Mr. STORRS. Yes. I would like to have it all in the record.

Senator MURDOCK. It may be received and made a part of the record. [Applause.]

STATEMENT BY K. L. STORRS, PRESIDENT AND GENERAL MANAGER, COAL LOGS CO., SALT LAKE CITY, UTAH

GOVERNMENTAL COOPERATION IN FACILITATING THE BUILDING AND OPERATING OF THE STATE-SPONSORED COAL LOGS PLANT FOR PROVING THE MANUFACTURING OF SMOKELESS FUEL, BLAST FURNACE COKE, AND RELATED BYPRODUCTS, AND A PROBABLE MEANS FOR PROVING ECONOMICALLY POSSIBLE, THE EXTRACTION OF OIL FROM OIL SHALE AND OIL SANDS

I. COMPANY PERSONNEL

Mr. K. L. Storrs, president and general manager.

Mr. A. D. Lamb, vice president.

Mr. E. LeRoy Shields, secretary-treasurer and attorney.

Mr. A. H. Hougaard, attorney.

Mr. George W. Carter, engineer.

II. FOREWORD

We believe that we have arrived at a definite and practical solution to the problem of manufacturing smokeless fuel, blast furnace coke, and related by-products. And that our simple and economical process provides the key to large scale production of liquid fuels, from the coals of Utah and other areas.

NOTE.—Kindly refer to Report of Production of Blast Furnace Coke by the Coal Logs Process and Supplement to Report by K. L. Storrs, submitted herewith.

III. PROPOSAL

That the Government cooperate with the State of Utah, in facilitating the immediate building and operating of the proposed 50-ton coal logs, carbonization plant, to the end that this plant will make available to the Bureau of Mines an economical and efficient means for testing all coals, oil shales, and oil sands of the West and other areas of the United States.

NOTE.—I should like to quote from a letter of R. R. Sayers, Director of the Bureau of Mines, Washington, to Hon. Senator Murdock, dated November 9, 1942. This letter sets forth the report of Supervising Engineer J. D. Davis, who had visited us and who had discussed our process.

"It is fortunate that the State of Utah has made arrangements with Mr. Storrs for constructing the 50-ton pilot plant. The Bureau believes that this should be done and will be glad to cooperate in any feasible manner in these

pilot-plant studies, not only with reference to Utah coal, but also through other kinds of coal in other parts of the country.

"The production of smokeless fuel probably will be one of the newer industries that will be vigorously pushed after the war. St. Louis, Mo., has led the way in passing municipal ordinances requiring the use of smokeless fuel in hand-fired domestic furnaces. Pittsburgh, Pa., probably will follow with similar regulations after the war and this idea will sweep through other cities in the United States. Such requirements will favor the establishment of smokeless-fuel processing plants. The Bureau of Mines is ready to cooperate wherever feasible in the development of suitable processes."

IV. SALIENT DEVELOPMENTS TO DATE

From 1939 to the present date K. L. Storrs and associates have been continuously developing and patenting process and apparatus for the low- and high-temperature carbonization of western coals.

In 1941 George W. Carter was employed to work out a design in detail, following our plans, for the construction of a demonstration unit. The present demonstration unit was the result, built by the Lundin & May Machinery Co., Salt Lake City, the unit was finished in the summer of 1941 and operated continuously to satisfy ourselves and others that the manufacture of coal logs was not only commercially feasible, but that a 50-ton pilot plant would be the only logical next step in our development.

In the fall of 1941 Carol Lombard assured us of the finances to continue with our plans for building the 50-ton unit, and we ordered and purchased nearly everything needed.

At the death of Carol Lombard we were left without the finance to continue our 50-ton plant as planned.

Priorities asked for late in 1941 were granted in February 1942. These under P. D. 1A application.

In the spring of 1942 we began negotiations with the State of Utah, and after over 9 months of thorough investigation, Governor Maw, upon recommendation of his Publicity and Industrial Development Commission, agreed to release \$35,000 for the erection of the contemplated plant.

In January 1942, due to the fact that the priority ratings already obtained no longer were of use in making the necessary purchases, the War Production Board was solicited for priority assistance and permission to build this plant.

In April our request was denied on the basis that research work had been discontinued and that no data were submitted to show the physical and chemical properties of the byproduct tars.

Actually research has continued without interruption and ample information was submitted through Senator Abe Murdock regarding the byproducts. In fact, we have recently extended the original low-temperature carbonization process to make excellent blast-furnace coke for the steel industry. This development was made known to the War Production Board, although their correspondence made no reference to it and indicated that denial of priorities was made entirely on the low-temperature carbonization basis.

We have built a table model of the commercial plant to demonstrate the continuous production of blast-furnace coke in cylinders three-quarters inch in diameter. There is some work yet to be done on this model before we can make demonstrations with it, but we are making arrangements now to complete the machine in the near future.

Senator Abe Murdock, on April 22, advised us by wire that the case had been reopened and that an expert consultant would be in Utah on May 4. The same day Donald B. Keyes phoned Mr. Storrs, and Mr. Keyes stated, from his office in Washington substantially the following: "I have just received a copy of the Utah Coal Research Foundation Report, and other data. There has been buck passing in your case Mr. Storrs and I want to tell you that the buck passing stops at my office."

Dr. Moore arrived on May 4, was taken to the various places where materials are now assembled for the contemplated commercial plant, was taken to the site at 822 Fourth West and to the university where he observed the table model manufacturing a smokeless fuel at a rapid rate. While here he met with the State department of publicity and industrial development, and with Gov. Herbert B. Maw. He was introduced also to B. L. George of the Republic Creosoting Co. who assured him "there is a crying need for all the byproducts of low-temperature

coal tar, in the West. We can take tar of any kind, low or high temperature—good or bad and dispose of it at this time. We are rated as a defense industry. All of our tar products are sold under the supervision of the United States Government. We are told where to ship every product that we produce. I can assure you that we can take all of the tars that the Coal Logs Co. can produce with the contemplated plant and a lot more. We will be glad to have their product."

Upon Dr. Moore's return to Washington, we received correspondence from him indicating that in his opinion we should be granted priorities for materials for small-scale experimentation.

We feel that we have progressed to a point where further small-scale experimentation would not only be pointless but we would be redoing all that we have done over the past 4 years.

Early in July, Mr. A. C. Melting, regional technical advisor of the War Production Board, 408 Atlas Building, Salt Lake City, Utah, met with the publicity and industrial development department at the request of K. L. Storrs and stated that under War Production Board order No. P-56 that there was a good possibility of our continuing our proposed plan. On July 14 Mr. Melting was asked to ascertain definitely from his Division whether we can build and operate this plant under the provisions of this order.

We have not as yet received a definite decision in regard to our PD 200 application which was placed before the board of referees of the Chemical Division of the War Production Board.

We are awaiting now also Mr. Melting's decision.

In the meantime we have found all items necessary for the construction of our proposed plant and we will need priorities upon only three of the needed items.

V. CLAIMS MADE

(1) Cost: Plant to treat 1,000 tons raw coal daily to manufacture smokeless fuel, \$300,000, including \$50,000 operating costs. Cost of plant for making by-product or blast-furnace coke is estimated at \$650 per ton of daily coal capacity. Beehive ovens cost \$670 and byproduct ovens cost \$3000 on the same basis.

(2) Time required for production of 1 ton of coke is estimated at 0.4 hour, while beehive and byproduct ovens require 16 hours and 1.9 hours, respectively.

(3) Yield of tar byproducts is estimated at 25 to 30 gallons per ton in a commercial plant. This is about double the present yield from byproduct coke-oven plants. Beehive ovens do not recover the tar.

(4) Phenols amount to almost 40 percent of the total tar yield, being about double the present amount obtained. Phenols are used in the manufacture of plastics, creosote, and flotation reagents for the mining industry.

(5) The blast-furnace coke will be uniform as to composition, high strength, and density. The size can be made to suit blast-furnace operating conditions.

(6) Critical construction materials are relatively small. The most critical are apparatus for the control of pressures and temperatures. A detailed list of materials for the proposed 50-ton-per-day plant has been furnished the War Production Board.

(7) Coals suitable for byproduct coke manufacture by this process are any noncoking bituminous Utah coal. Other western bituminous coals also may be suitable. Therefore, it is now possible to utilize the vast reserves of non-coking coals to supplement the use of our rapidly diminishing supplies of coking coals.

(8) Research conducted by Mr. Carter and others indicates the possibility of making aviation gasoline from the tar. Yield would be from 5 to 6 gallons per ton of coal treated.

(9) Electrode carbon: After the resins have been removed by Dr. Adrian Nagelvoort's process, and the ash has been reduced by his method, the resultant coal should provide excellent material for the manufacture of electrode carbon for the aluminum industry.

(10) We feel that we have a method of progressive distillation that should greatly facilitate the recovery and handling of the byproducts incident to smokeless fuel and coke manufacture. (This phase of our process to be proven in our laboratory unit prior to the construction of the additional coking unit.)

VI. REASONS FOR BUILDING PILOT PLANT NOW

(1) To provide a sufficient supply of byproduct coke for trial in actual blast furnaces.

(2) To produce sufficient quantities of byproduct tar for analysis by commercial tar refiners. And for the hydrogenation process as it may be applied to the tars. The properties of primary tar we would produce have been determined only in the laboratory. It now remains to subject the tar to commercial inspection so that its industrial uses may be well established.

(3) To prove that the coal log process offers a practical method: (a) Of meeting the growing demands of the steel industry for satisfactory coke, (b) of alleviating the shortage of coking coals, (c) of alleviating the shortage of creosote, phenols, flotation reagents, benzol for synthetic rubber, (d) of supplementing our supply of petroleum and its products which now are being consumed at an unprecedented rate, and (e) of aiding in the manufacture of electrode carbon for the aluminum industry.

(4) To create a new industry which will offer employment in the post-war era.

(5) To provide a suitable fuel for the post-war elimination of smoke from Utah's cities, with the possibility that other cities may also solve their smoke problems by this method.

VII. LARGE PLANT POSSIBLE

A large plant of from 500 to 2,000 tons of coal per day can be safely constructed upon the basis of performance data obtained with the pilot plant. Construction of the large unit could begin within 90 days after the smaller plant is placed in successful operation. Total construction time for the pilot plant will require upward of 3 months depending upon availability of materials. Approximately 70 percent of these materials already has been purchased from new and second-hand stocks. Thirty days would be required after construction to place the pilot plant in satisfactory operation.

VIII. CONCLUSION

We believe that our expenditures approximating upward of \$25,000 plus our work in experimentation offers an immediate solution to the problem confronting the War Minerals Committee and that the adoption by the Government of our process will save the Government much time and money.

Time is the essence in this war effort and the production of essential items rapidly is the keynote. We ask the immediate cooperation of the Government in this matter so that this work, so vital to the Nation, can be continued to the end that actual production may be had in the near future.

SUPPLEMENT TO REPORT OF PRODUCTION OF BLAST FURNACE COKE BY THE COAL-LOG PROCESS

(By K. L. Storrs, president and general manager, Coal Logs Co., Inc.)

Referring to the report by George W. Carter herewith, as inventor of the coal-log process and coworker with Mr. Carter for the past 2 years or more, I wish to state that Mr. Carter's comparison of costs for making blast-furnace coke are, in my opinion, ultraconservative. The above-mentioned figures are based upon 100 tons of raw coal throughput daily, the yield of coke 59 tons, 24 hours, one retort. Quoting from a letter by George W. Carter to Dr. A. C. Fieldner, Chief, Technologic Branch, United States Bureau of Mines, Washington, D. C.:

Our process comprises the continuous distillation of a thin layer of coal which moves over an externally heated and vibrating horizontal retort. The coal is carbonized to 400° to 430° C. until the semiplastic stage is reached, whereupon it is compressed continuously into log form. This heating method is quite similar to that of the Piron-Caracristi process for which performance data are given in Dr. Fieldner's Report No. 396. Based upon this information, the capacity of the proposed plant would be around 200 tons per day, which is four times greater than we have guaranteed. We believe that we have a revolutionary method for low-temperature carbonization, not only because of the rapid distillation, but also because we can utilize fines now wasted to dumps particularly at

the two Utah washing plants, and convert this material into a strong, solid smokeless fuel. Estimated cost of proposed plant is \$35,000 and includes \$10,000 working capital. I know that these figures will appear to be much too low, but I can assure you that they are right.

Quoting also from report by George W. Carter to the Industrial and Development Commission of Salt Lake City, Utah, comparison of the Lurgi and coal-log processes and under the item "carbonizing time":

"Caracristi process tried by Henry Ford, 400 tons were treated per day with 150 square feet surface, since the method involved carbonizing thin layers of coal in a fashion comparable to the coal-log method, every indication points to duplication of these results. Thus 220 pounds may be treated per square foot per hour."

Reference to Caracristi process, A. C. Fieldner, in the United States Bureau of Mines Technical Paper 396:

"The Piron-Caracristi process adopted by the Ford Motor Co. has attracted much attention. An oven with a capacity of 400 tons a day, about 50 feet long and 4 feet wide, was completed in 1924 at Walkerville, Ontario. * * * The crushed coal is charged into a series of shallow cast-iron pans 36 by 18 by 1 inch deep, which are part of a continuous chain belt. The coal layer is about $\frac{5}{8}$ -inch deep. During the carbonization period the coal particles do not move in relation to each other, but are free to swell, become pasty, and fuse into a sheet of coke, which detaches itself from the trays during the return of the belt. Heat is applied to the coal through a bath of melted lead. * * * Although the quantity of coal in each pan is small, the time necessary to permit satisfactory carbonization of the thin layer of coal is so short (less than 5 minutes is the claim) that the furnace as a whole may have a large daily output."

"Preliminary operation of this plant at Walkerville showed that all details of design had not been worked out satisfactorily. It is a question if metallurgical science has yet developed a method of constructing, at reasonable cost, a chain mechanism suitable for operation over a long period at a temperature of 650° C. It is also difficult to design a charging and discharging mechanism that will never admit excessive quantities of air into a large retort space. * * *"

As a comparison, I will refer now to paragraph 2 of the Caracristi process. It will be noted that crushed coal is charged into a series of shallow cast-iron pans 36 inches by 18 inches by 1 inch deep, the coal layer is about five-eighths inch deep.

Referring to paragraph 1, the Caracristi retort is 50 feet long and 4 feet wide. The fuel bed itself would be 50 feet long by 3 feet wide by five-eighths inch deep. Coal Logs retort of the proposed plant to be built for the State of Utah, horizontal and rectangular in shape, is 2 feet wide by 35 feet in length and the contemplated fuel bed is six-tenths of an inch, but assuming our retort to be 3 feet by 50 feet and our fuel-bed depth to be the same as that of the Caracristi process, then we would treat, heating the coal only from one side and without any agitation of the coal particles, 400 tons of raw coal per day.

(NOTE.—My research work in reference to the depth of fuel bed that can be treated has shown that when crushed coal of minus one-fourth inch in size or smaller is thoroughly agitated during treatment, that a fuel bed of 1 inch depth can be carbonized as rapidly as a fuel bed of six-tenths of an inch or less. Since I did not carry my research further to attempt treating fuel beds of greater thickness, I cannot definitely say that we could treat more than an inch depth. However, it is my opinion that the treatment of a $1\frac{1}{2}$ - or 2-inch fuel bed would be possible. Treatment of a 1-inch fuel bed would mean as per the Caracristi process and consequently with a Coal Logs retort of 3 feet by 50 feet that 640 tons of raw coal could be treated per day.)

Also, my own independent research has shown that a fuel bed of 1 inch or less thoroughly agitated can be carbonized in from 1 minute to $1\frac{1}{2}$ minutes.

Regarding the heating surface in the Coal Logs retort now under construction, this retort, 5 inches deep by 2 feet wide by 35 feet in length, heated only from the bottom as in the Piron-Caracristi retort, would have a heating surface of 70 square feet in comparison to 150 square feet of heating surface Caracristi. However, the Coal Logs retort is heated top and bottom, thus having 140 square feet of heating surface. Upon this basis the capacity of raw coal for 24 hours of the Coal Logs retort would be 373 tons. Reckoned upon a 1-inch fuel bed in place of five-eighths inch fuel bed, this would be approximately 596 tons raw coal treated daily. To be absolutely certain of realizing our expectations as to capacity, we have estimated and stated that this retort now under construction

(2 feet by 35 feet by 5 inch depth) would treat, certainly, 100 tons per day of raw coal.

Our 100-ton stated capacity for a 2 foot by 35 foot retort is based upon a fuel bed of five-eighths inch depth. Since I have proven definitely that a 1-inch fuel bed can be treated as rapidly as a five-eighths-inch fuel bed, and staying with Mr. Carter's very conservative estimate of 100 tons' daily capacity, and adding only the increased depth of fuel bed, I feel that I can state definitely a capacity of 160 tons raw coal daily and I feel certain in my own mind that figures consistent with those given in the report on the Caracristi process would be more nearly correct.

Referring again to comparison of costs by Mr. Carter, it will be noted that confining any increase in the stated capacity to that brought about by the increased depth of fuel bed, figures shown for the coal-logs process would be changed appreciably for the better. Reckoning upon a capacity consistent with the Caracristi output, the figures shown by Mr. Carter in the comparison of costs for the Coal Logs process would be radically changed for the better.

Based upon our estimate for a plant to treat 1,000 tons raw coal daily to manufacture smokeless fuel—which is \$300,000 including \$50,000 operating costs—a 500-ton plant to manufacture smokeless fuel would cost something between \$150,000 and \$175,000. Mr. Carter, in his estimate of the cost of a plant to treat 500 tons of raw coal for the manufacture of coke, has estimated the increased cost of the plant due to the necessity of added tar and byproduct handling equipment at over \$300,000 or \$125,000 to \$150,000 for additional byproduct-handling equipment.

In my opinion, this is a very high figure for the 500-ton coking unit and most certainly conservative.

I feel that we can reasonably expect that a plant to treat 500 tons raw coal daily and to manufacture coke and extract the byproducts therefrom, will not cost over \$225,000, in which case the figures as shown in Mr. Carter's report would be again changed for the better.

I should like to add, in connection with the tar and byproduct handling equipment, that I feel that we have a method of progressive distillation that will greatly facilitate the recovery and handling of the byproducts incident to coke manufacture. (This phase of our process to be proven in our laboratory unit prior to the construction of the additional coking unit.)

Due to the fact that time is of the essence in this war effort, and that the production of essential items rapidly is the keynote, and add to this the fact that we can deliver a uniform product, of uniform density, from noncoking coals—thus opening vast coal resources to the steel industry—and I believe that our case is clear and offers ample incentive to the War Production Board for the granting of priorities to obtain the handful of equipment necessary to begin construction and operation of this needed pilot plant.

Our plan is to not long remain a pilot plant, but to add units and increase our capacity as rapidly as we are called upon to do so. The time required to build plants of the Coal Logs design would be short in comparison to that required for others. Thirty to forty days should build a plant, provided labor and materials are on hand.

THE PRODUCTION OF BLAST FURNACE COKE BY THE COAL-LOG PROCESS

(Statement of George W. Carter, chief engineer, Coal Logs Co., Inc., Salt Lake City, Utah)

PRODUCTION OF BLAST FURNACE COKE

Types.—Coke is produced in both beehive and byproduct ovens. Tars and fuel gas are recovered only by the latter method. Before the war, approximately 95 percent of the 61,000,000 tons of coke made in the United States came from byproduct ovens. Approximately 70,000,000 tons of coke were produced in 1942. The War Production Board estimates that 75,000,000 tons will be required in 1943 and 79,000,000 in 1944. Ten percent of the 1943 and 12 percent of the 1944 production will be beehive coke.

Beehive ovens are the least costly to construct, but the energy required to operate them is four times that required for byproduct ovens. Beehive ovens are wasteful in that none of the volatile constituents are saved. The average 1940 gross revenue in the United States for the products recovered from this volatile of byproducts ovens amounted to \$2.663 per ton of coke. The consumption of by-

product coke per ton of pig iron manufactured is from 100 to 300 pounds less than of beehive coke, in the same operation.

Dr. Fieldner says that "Resumption of beehive coking is a temporary expedient and regrettable from several points of view. Because of lack of technical supervision and of adequate coal preparation facilities, many of the beehive installations are making poor coke of variable ash and sulfur content which cuts down greatly needed blast furnace capacity. It is, moreover, unfortunate that no byproducts are recovered in the beehive process, yet all of these are very important in the war program."

Problems.—The expansion program (2) calls for the construction of 1,904 new byproduct and 500 new beehive ovens by 1944. Also, 344 old byproduct and 8,500 old beehive ovens are to be rehabilitated. The author estimates the cost of this program to be in the neighborhood of \$140,000,000.

The increase in coke production from 61,000,000 tons in 1940 to 79,000,000 tons in 1944 represents an increase of almost 30 percent. Such an expansion is bound to create new technical problems and to accentuate old ones.

Prior to the war, we were charging only the best coking coals in any given economic area to the coke ovens. The mines supplying these coals were found to be inadequate for present needs. New mines supplying satisfactory coal have been developed at considerable expense. Even with the attending increased production, we are searching for methods to utilize coals heretofore considered unsuitable for coke manufacture. These are "borderline" coals which swell upon heating and cause extensive damage to the coke ovens. By blending a suitable non or slightly swelling coking coal with a "borderline" coal, a satisfactory coke may be produced. The blending of coals, however, adds somewhat to the production cost.

One of the most difficult problems confronting coke manufacturers of the West is that of finding adequate supplies of suitable coking coals. Studies are under way by the Bureau of Mines at Golden, Colo., and also by the research committee at the University of Utah. There doubtless are private interests searching for a satisfactory solution to this problem.

Another problem is that of obtaining coke of uniform quality, structure, and size. Also, there is a "growing tendency to a higher ash content and higher sulfur content."

The West is fast becoming industrialized as a result of our war program. Vast quantities of coke are required for its steel and industries. The coal deposits of Utah are nearest of any to the Pacific coast area. Utah's limited reserves of coking coals are being extensively mined for the production of coke both in and out of the State. The Utah Fuel Co. is supplying the Kaiser interests with coking coal and has 294 beehive ovens at Sunnyside, Utah. Only 30 of these ovens are in operation, due chiefly to an insufficient supply of coking coal. There are 330 new beehive ovens and 60 new byproduct coke ovens under construction in Utah by the Columbia Steel Co.

In view of the problems attending increased coke production and the strategic situation Utah occupies in the picture, Coal Logs Co. believes that it has a process of coke manufacture which will aid the war effort materially.

Reasons for this statement appear later in the report.

RELATION OF COAL CARBONIZATION BYPRODUCTS TO WAR

The role of byproducts is becoming increasingly important for national defense requirements (5). Dr. Fieldner has ably summarized their importance as follows:

"About half of the (fuel) gas (produced in byproduct coke ovens) is required to heat the coke ovens, and the remainder is used for heating purposes in nearby steel plants or distributed in city gas lines. All other byproducts are of very direct importance for the manufacture of munitions or essential war equipment. The light oil contains benzol and toluol. Benzol is our only source of styrene, which comprises 25 percent of the composition of synthetic rubber. Picric acid—used in explosives—also is made from benzol. Benzol is converted to phenol (carbolic acid), and large quantities of the latter are used in the manufacture of bakelite and other plastics. Toluol is the basis for TNT, which is employed in shells and mines. The quantity of toluol available from coal carbonization is inadequate to meet the needs of the present war. Fortunately, toluol can be made also from petroleum, and sufficient quantities are being supplied from this source.

"Coal tar provides phenols, cresols, and higher-tar acids, which are in great demand for the rapidly growing plastics industry, and uses are even found for all the pitch that can be made (although it formerly was a drug on the market)

in the production of carbon electrodes for the expanding aluminum industry. Ammonium sulfate is used in the manufacture of explosives. In fact, much additional ammonia must be made directly from the nitrogen in the air to supply the large quantity required in modern warfare. Here, also, coal plays an important role in the manufacture of hydrogen from water gas. * * * In addition to these principal products, coal tar is the source of a large and varied list of medicinal preparations, photographic chemicals, dyes, and miscellaneous chemicals."

In addition to the above products, past researches conducted on Utah coals have indicated the possibility of producing aviation gasoline from the neutral tar oil. Approximately 5 gallons per ton of coal may be obtained.

THE COAL LOG PROCESS FOR THE MANUFACTURE OF BYPRODUCT COKE

Earlier reports have described the above process for the manufacture of low-temperature coke from the noncoking coals of Utah. Briefly, this process takes crushed coal, the fine slurry from washing plants or the fines rejected at the mines, and feeds this material continuously into a horizontal vibrating retort in which the coal attains a temperature of from 400° to 420° C. At this temperature the Utah coal is semiplastic, and is molded continuously by means of a motor-driven worm into cylindrical form. The resulting product, known under the copyrighted name of "Coal-Logs", is a solid smokeless fuel containing from 18 to 22 percent volatile. It is strong, coherent, homogeneous, and will ignite as readily as raw coal.

Within the last few months, Coal-Logs Co. has investigated the feasibility of further heating the logs to a temperature of 900° to 950° C. The object of this extended carbonization is to produce a satisfactory byproduct coke for metallurgical purposes. Noncoking Utah coals have been placed in a one-half inch diameter pipe and heated to 950° C. in a standard Fieldner volatile matter furnace. The resulting coke had the characteristic silvery lustre and metallic ring, was free from the usual large pores, possessed unusual density, and 3-inch lengths could not be broken by hand or by dropping them on a concrete floor from a height of 5 feet.

To the commercial plant for which priorities are now sought, the company would add refractory tubes through which the bolded logs would pass to attain a temperature of from 900° to 950° C. Additional condensers, tar storage tanks, Cottrell precipitators, and gas handling equipment would be required. Also scrubbing towers for the removal of ammonia and light oil would be needed. The cost per ton of daily capacity and other economic data are presented below.

Comparison of costs for making blast-furnace coke

	Beehive ovens ¹	Byproduct ovens ²	Coal logs ²
Construction cost per ton of daily coal capacity, dollars..	670	3,000	650
Yield of coke, percent of raw coal..... tons..	50	59	59
Carbonizing time per ton of coke..... hours	16	1.9	0.5
Manufacturing cost per ton of coke, excluding coal cost..... dollars..	2.00	3.25	1.60

¹ Based upon 200 ovens.

² Based upon 500 tons of coal per day.

SUMMARY

The foregoing table and data show that blast-furnace coke may be produced by the coal-log process in about one-fourth the time required by the byproduct ovens and 32 times less than that required for beehive ovens, but is approximately one-fifth that for byproduct ovens on a comparable basis. Coking costs are 20 percent less than for beehive coke and 50 percent less than for byproduct coke.

With increased coke production of primary importance in today's war program, and with supplies of steel, brickwork, and other strategic materials being more difficult to obtain, it appears that the coal-log process has a solution to the problem. As a result of primary rather than secondary decomposition of the volatiles, the yield of tar from the new process will be from 2 to 2.5 times greater than from the Utah byproduct-coke ovens.

We are convinced that any noncoking bituminous Utah coal can be formed into strong and homogeneous blast-furnace coke. Utah coals are relatively low

in ash and sulfur. Thus the field of suitable coals is widened considerably beyond its present boundaries.

The coal-log process does not require the blending of raw materials nor the addition of binders.

The coke would be continuously uniform in size, shape, and density. These properties could be regulated to meet requirements of the blast furnace.

Of course, the suitability of the new blast-furnace coke remains to be proven. This can be done only by operation of a pilot plant such as is now proposed. The equipment required (in addition to that already included in Form PD-200) will consist chiefly of refractory materials and little, if any, steel.

In view of the urgency of increased coke and coal-tar production, and the material aid that the coal-log process offers to the problem, the writer believes that the necessary governmental assistance should be granted. If our claims are proven substantially correct, then the money and materials consumed will have yielded results of great benefit to the Nation. On the other hand, if this project does not prove feasible as indicated, then the money and materials consumed will have been insignificant in comparison to the magnitude of these items daily expended in new developments linked with our war effort. The writer is so thoroughly convinced of the practical nature of this process that he is staking his future professional success in it.

STATEMENT OF ADRIAN NAGELVOORT, CHEMICAL ENGINEER, SALT LAKE CITY

Mr. NAGELVOORT. My name is Adrian Nagelvoort. I am a chemical engineer of Salt Lake City. I have been interested in byproducts of the Utah coal. The subject that I am to talk about is "Fossil Resins for Paint and Varnish Industries from Utah Coals." I will submit this article for the record.

Senator MURDOCK. It may be received, and will be made a part of the record.

(The article referred to is as follows:)

FOSIL RESINS FOR PAINT AND VARNISH INDUSTRIES FROM UTAH COALS

America's supply of natural resins has been wholly dependent on foreign sources that are now cut off. The East Indies shipped us damar, pontianak, boea, and loba. From the Philippines we got manila, from New Zealand kauri, from Australia sandarac and accroides, from Africa sandarac mastic and congo copal. In the trade these resins are usually designated as "gums" but this is, of course, a misnomer. They are true resins and are either of fossil origin or are tappings from standing trees. They have one characteristic in common; all are used in making protective coatings, in oil varnishes, spirit varnishes, or incorporated in paints, lacquers, inks, or linoleums. Most highly prized are the fossil resins, since they make the best and most satisfactory coatings for most industrial purposes.

Utah has a deposit of fossil resin great enough to satisfy our entire domestic needs for the next hundred years or more. In origin these are similar to the imported fossil resins in that both are from prehistoric coniferous trees. Geologically those of Utah are much older and hence in some respects are better for making protective coatings.

Toward the end of the Cretaceous time and before the beginning of the Tertiary period the western plains were covered with dense forests of conifers, the ancestors of our sequoias and pines. Such trees are prepared for a long life because of their effective means of protection, including waxes that cover their leaves and resins that protect their bark and wood. These resins and waxes probably represent nature's best chemistry in the making of protective coatings.

Certain seams of the Cretaceous and early Tertiary coals of Utah contain the fossil remains of the resins and waxes of the conifers of those times. These coals are bituminous, but are much younger than the bituminous coals of the eastern seaboard and the Middle West, which are of the Carboniferous period or about twice as old. Geologists estimated their age as between 30,000,000 and 80,000,000 years. That these resins have withstood for so long the corrosive

action of ground waters that have been acid and alkaline as well as salty shows that nature's chemistry has been good. Indeed it has been so good that the protective coatings have withstood the ravages of time better than the wood fibers they were meant to protect.

In the Utah coal field between Castlegate on the north and Salina Canyon on the south, a distance of 70 miles as the crow flies, there are certain seams about 14 feet in thickness in which the resins constitute about 5 percent of the coal. The resins look like amber and vary in color from water-white through lemon yellow to deep, dark red. They occur in lenses from paper thin to 1 inch or more in thickness.

While these fossil resins have been known locally for a long time and attempts have been made from time to time to use them commercially, the difficulties connected with their use were not overcome until recently. Two main problems had to be overcome to prepare these resins for commercial acceptance. The first was the technique of mineral separation to recover the resin cleanly from the coal. The next was that of processing the recovered resins so that they could be used in the making of light-colored varnishes to meet the varnish maker's most severe tests.

The usual mineral separation processes were tried without any noteworthy success. A new "sink and float" technique was developed, however, which gave a clean separation of the resins from the coal and also a clean separation of the waxes from the resins. This latter is important to the varnish maker who cannot tolerate any wax in his varnish.

A chemical study of the resins revealed the fact that these resins contain an asphalt in solution. And this asphalt was the real "nigger in the woodpile." It caused the varnishes made from the resins to craze and crack and have a very dark color. Removal of the asphalt solved the problem of making a commercially acceptable resin.

Utah now mines more than 100,000 tons of coal a week. The miners avoid the resin-bearing coals as much as possible as some consumers object to its speckled appearance and the excess soot it produces. However, about 15 percent or some 15,000 tons is resin bearing. With an average of 5 percent resin content this represents about 100 tons of resin per day that goes up in smoke and soot to dirty our cities. Some day the waste of this valuable resin will be considered as one of the most shameful wastes of our natural resources. But important steps are being taken to stop this waste. Furthermore, the utilization of these resins at this critical time would release for more important war uses some of the glycerine, alcohol, phenol, and other chemical that are now being used in large quantities in making synthetic resins. World War I exploded the idea that only Germany could make dyes and fine chemicals. This present war should free the United States of dependence on foreign sources for its supply of natural varnish resins.

The establishment of a new industry in a community invariably brings other industries in its wake. Utah should never again allow raw materials or crude ores to be shipped out of the State for processing into finished products. The processing industries are more remunerative than the production of the raw materials. The building of a resin industry in Utah should bring some varnish makers who in turn would bring a castor-oil industry giving the farmers a new crop. An alcohol industry to use our waste potatoes and sugar beets and grains would follow. And these in turn would bring in others all related to a resin industry. Fortunately, the pioneer spirit is still strong in Utah and there are men of vision in its Government.

United States imports for consumption of varnish gums

[In pounds]

	Damar	Kauri	Other varnish gums	Total
1935	15,004,904	1,386,821	20,569,307	36,961,032
1936	15,707,671	970,484	20,383,225	37,961,380
1937	18,167,512	2,139,207	24,788,544	45,095,263
1938	11,541,965	767,014	16,494,033	28,803,012
1939	17,334,581	1,020,632	23,941,313	42,296,526
1940	19,110,593	1,561,135	33,360,745	54,032,473
1941 (9 months)	19,138,415	533,690	23,152,196	42,824,301

Mr. NAGELVOORT. The Utah fossil resins coal beds are about 14 feet thick, which would indicate a tonnage of astronomical figures. The coal contains about 5 percent resins. These resins are worth five times as much as the coal, so that if it becomes necessary to produce oil or other products from the coal the resins could really bear the burden of the cost. And it is merely to get this information in the record that I am here today.

Senator O'MAHONEY. What is the type of the resins?

Mr. NAGELVOORT. The resins look like amber and they belong to the amber class of minerals; they are the residue of the original pine trees which existed here 30 to 50 million years ago. These resins are the resins that are used by the paint and varnish industry, and which the paint and varnish industry heretofore imported from such countries as the East Indies, the Philippines, New Zealand, and Africa.

Senator O'MAHONEY. Can they be recovered in quantity?

Mr. NAGELVOORT. Yes. The quantity that can be recovered is enormous.

Senator O'MAHONEY. What effort has been made to recover them?

Mr. NAGELVOORT. I have worked on the problem for 4 years, and others have been on the problem for a still longer time, but it is only recently that we have been able to treat these resins in such a way that the varnish industry would accept them, and that has been within the last year.

Senator O'MAHONEY. In a laboratory manner, or a commercial manner?

Mr. NAGELVOORT. On a small pilot plant scale. I have produced better than a ton of these resins and sent them out to the trade for their tests.

Senator O'MAHONEY. A ton, over what period?

Mr. NAGELVOORT. About a year. Now I am preparing to produce a ton a day of these resins from 20 tons of coal.

Senator O'MAHONEY. And your recommendation is that the possibility of making this recovery should also be studied?

Mr. NAGELVOORT. Yes.

Senator O'MAHONEY. By the Government?

Mr. NAGELVOORT. By the Government. Because later on, the Government will probably be called upon to build a larger resin recovery plant, since private industry won't furnish it.

Senator MURDOCK. Thank you, very much.

Mr. Alfred M. Buranek, Geologist for the State Department of Publicity and Industrial Development, desires to submit this statement which will be made a part of the record.

**STATEMENT OF ALFRED M. BURANEK, GEOLOGIST, UTAH STATE
DEPARTMENT OF PUBLICITY AND INDUSTRIAL DEVELOPMENT,
SALT LAKE CITY, UTAH**

In a discussion of the feasibility of producing oil from coals, oil shales, or other oil-bearing substances, the byproducts obtainable from the raw materials are naturally of extreme importance. One such product which is present in certain coal measures of Utah and well exhibited in the coals of Salina and Huntington Canyons, is resin. The resins of these coal seams are similar to the resins of commerce which are utilized in the making of fine lacquers, varnishes, and other products suitable for protective coatings. The coals of Salina and Huntington Canyons contain from 3 to 8 percent resin with an average of approximately 5 percent.

Directly because of the interest given to Utah resins by various parties during the past few years, the Utah State Department of Publicity and Industrial Development authorized Arthur L. Crawford, geologist and mineral technologist for the engineering experiment station, University of Utah, and myself, geologist for the Utah State Department of Publicity and Industrial Development, to make a preliminary investigation of these coals with particular reference to the resin content. This was done and the report herewith presented for the record is the result of this study.

(The report is as follows:)

NOTES ON RESINOUS COALS, SALINA AND HUNTINGTON CANYONS, UTAH

(By Alfred M. Buranek and Arthur L. Crawford)

INTRODUCTION

Considerable interest during the past year has been given to the resin-bearing coals of Utah, particularly those of Salina and Huntington Canyons. The resin content contained in the coal measures of these two canyons varies from practically nothing to as high as 14.9 percent. Inasmuch as it is a recognized fact that the resins contained in Utah coals and in other coals are similar to the fossil resins of commerce, which have been imported principally from the East Indies and that general region, used exclusively in the making of fine varnishes and lacquers, several parties have been "toying" with the idea of processing Utah coals to extract the resin content. With the original source of supply cut off by the war, and the demand for resins as great as it ever was, the idea of obtaining resins, providing it is economically sound, from Utah coals is highly justifiable.

Inasmuch as representatives of large paint concerns, and other interested persons, have given much consideration to the coals of Salina and Huntington Canyons, it is logical to assume that these coal measures contain as high if not higher a percentage of resin than other coals in the United States. Further, as resin has been known to occur in coals for many years, and that this resin is similar to the copals now used in varnish making, there is evidently a very good reason why it has not been obtained from coals, particularly European, as many of them are broken down into hundreds of valuable by-products. (The above statement pertains to natural resins, not synthetic resins which are synthesized from byproducts of coal.)

The following data consists of a preliminary study of the resin-bearing coals of Salina and Huntington Canyons, Utah. It is by no means complete and represents only a compilation of notes and analyses of several of the coal measures examined. The problem will be studied further and the results will be published in bulletin form by this department in cooperation with the engineering experiment station, University of Utah.

HUNTINGTON CANYON

Byron Howard coal mine—The Byron Howard mine is located in the NW¼ sec. of sec. 11, T. 17 S., R. 7 E., in Deer Creek Canyon (a subsidiary of Huntington Canyon), Emery County, Utah. This mine has been opened on the Blind Canyon bed, which carries over 3 percent resin. The coal bed is roughly 14 feet in thickness, and the excellent roof and floor of this mine affords good mining conditions. The entries and rooms are all spacious. The mine is accessible over a fairly good dirt road in Deer Creek Canyon. The quality of the coal is high, as shown by the analysis below:

Air drying loss.....	2.6.
Volatile matter from.....	45.2 to 40.1.
Moisture.....	4.6.
Fixed carbon.....	45.1 to 49.9.
Ash.....	5.1 to 5.3.
Sulfur.....	0.64 to 0.71.
Calories.....	7,385 to 8,175.
B. t. u.....	13,290 to 14,720.

The above analysis taken from United States Geological Survey Bulletin 819, page 71.

The resin seams in the coal strike north 40° west. According to Mr. Howard, the present output of the mine is, roughly, 200 tons per day, of which approximately 10 percent is bug dust. However, an increased production is antic-

ipated to reach 400 tons per day, as Mr. Howard obtained a Government contract of 13,000 tons of coal. Some 200 pounds of bug dust was collected to be analyzed. Also, a rough estimate of the fines and bug dust contained in the dump was made. According to calculations on the dimensions of the dump and specific gravity of the coal, this dump roughly contains 72,000 tons. This was further checked by calculating that for the past 10 years approximately 20 tons a day has been waste coal ($20 \times 365 \times 10 = 73,000$ tons).

The main objection to utilizing the dump material is that it ignited through spontaneous combustion several years ago, and has been burning ever since. Thus, half of this tonnage is perhaps of no value.

Samples analyzed for resin, benzene (benzol) used as solvent, are as follows:

	Percent resin	Percent loss on extraction
Selected lumps high grade.....	6.4	6.4
Bug dust (coal fines).....	8.87	19.2

¹ Lost some too high.

Source: Professor Kinney (analyst), University of Utah, Salt Lake City, Utah.

American fuel coal mine.—The American Fuel mine, controlled by Malcolm McKinnon, is located several hundred yards to the southwest of the Howard mine and at an elevation of some 250 feet above it. McKinnon has probably developed the Blind Canyon vein, as the thickness of the vein, quality of coal, percentage of resin contained therein, and the geologic stratigraphic position of this mine is the same as the Howard mine. The area containing the Howard's holdings have been downfaulted, thus accounting for the differences in elevation of the two properties. The mine is accessible over a fair dirt road that serves both mines. Culinary and water for other purposes is readily available in Deer Creek.

The American Fuel mine produces approximately 45,000 tons of coal per year, of which roughly 10 percent of this total is bug dust. The mine is excellently equipped with the newest type of coal mining machinery, and is well suited to deliver large tonnages of coal. It is believed that the greater amount of coal mined from the Howard mine can be attributed to the fact that Mr. Howard is well known and has been in the business longer, whereas the American Fuel mine is a comparatively recent development. The occurrence of the resin is similar in every respect to that described for the Howard mine, although it appeared that in the latter mine the percentage of resin was slightly higher.

Samples analyzed for resin, benzene (benzol) used as solvent, are as follows:

	Percent resin	Percent loss on extraction ¹
Bug dust (coal fines).....	7.8	28.1
Machine drill across vein diagonally (14-inch thickness).....	3.2	3.2

¹ Represents a check analysis (by difference) on percent resin in first column.

² Sand present, not a fresh sample.

Source: Professor Kinney (analyst), University of Utah, Salt Lake City, Utah.

Notes on the Howard and American fuel mines.—From the above information, the Howard mine can produce approximately from 20 to 30 tons per day of coal fines, which carries from 8 to 9 percent resin. The American Fuel Mine is capable of producing, at present production, roughly 15 to 20 tons per day of this material with a similar percentage of resin. This total 50 tons or less per day of coal fines containing from 8- to 9-percent resin. Of course, it is to be understood that the larger the production of coal the greater the amount of coal fines is available. The above figures are directly related to present production.

The purchasing of this type of coal is probably the most feasible manner in which to obtain the very highest concentration of resin-bearing coal at the lowest cost. To obtain a larger tonnage per day the 1-inch slack should be investigated along with the coal fines, for if the 1-inch slack from both mines would

average 6-percent resin, and the coal fines 8-percent resin, a mixture of 50 tons of 6-percent 1-inch slack and 50 tons of 8-percent coal fines would total 100 tons per day of 7-percent resin-bearing coal. Therefore, if 100 tons of 7-percent (or even 6 percent to be conservative) resin-bearing coal is of economic significance, these mines show possibilities of being capable to supply such a product.

SALINA CANYON

Coals containing resin have been known to exist in the coal measures of Salina Canyon for a number of years, and although some consideration has been given to the exploitation of the resins by various interested parties, nothing has developed as yet. Spieker and Baker mention the occurrence of resin in all of the coal of the area. To supply local demand, coal has been mined intermittently from Salina Canyon since the time the region was first settled. However, to the knowledge of the writers, no mines are now in active operation. When the Sevier Valley Coal Co. was operating its coal mine 18 miles east of Salina, a small settlement known as Crystal City was located nearby. With the cessation of operations, the settlement was soon abandoned, and the nearest town to the district now is Salina. Spieker and Baker give the following description regarding the location of the district: The area described in this report includes a strip of land about 6 miles wide and 14 miles long, centrally located in the drainage basin of Salina Creek and extending from the Divide at the headwaters of the creek westward to the lower end of Salina Canyon. It forms part of a high plain between the still higher Wasatch and Fish Lake Plateaus to the north and south, respectively, and is trenched across by the deep gorge cut by Salina Creek. Practically all the accessible coal in and near Salina Canyon lies within this area, the western edge of which is about 8 miles by road from the town of Salina, in the Sevier Valley, on the Marysvale branch of the Denver & Rio Grande Western Railroad.

Water is plentiful in the district and any contemplated development could be certain of an ample supply of both culinary and nondomestic water needs. Salina Creek, which drains the area, flows continuously the year around.

The main road in Salina Canyon, State Highway No. 10, connects the towns of Salina and Fremont. Part of it, from Salina to the abandoned workings of the Sevier Valley Coal Co., is hard-surfaced and in excellent condition. The remaining section from there to Fremont is graded and drained.

The coal measures of the Salina Canyon district are all contained in the Blackhawk formation of Cretaceous age. Immediately above and capping the Blackhawk formation is the Castlegate sandstone, usually forming a prominent cliff wherever exposed. The Blackhawk coal-bearing formation is between 800 and 900 feet in thickness and consists chiefly of a brown and gray sandstone, shale, and coal. Underlying it is the Star Point sandstone and, although it is not exposed in the district, it has been encountered in diamond drill holes sunk by the Sevier Valley Coal Co. Throughout the Blackhawk are three coal beds or veins. From the lower to the upper they are the Ivie (locally confused with the Blackhawk, which according to the United States Geological Survey belongs to a horizon slightly lower in the same series), Sevier, and Wilson beds. The Sevier and Wilson beds should be mentioned as a group of veins because in many of the exposures two or more coal veins are present. The Wilson bed, for example, consists of three coal beds, the thickest being the middle member. With reference to the Wilson and Sevier beds, only the thickest are discussed.

The Ivie bed.—The Ivie bed is from 8 to 10 feet in thickness and represents the thickest and lowest bed in the district. The resin content, however, is exceptionally low and, therefore, it cannot be considered as interesting from a resin standpoint, as the other coal beds of the region. It has been developed by the Sevier Valley Coal Co. and the Boston Acme Co. The latter operated under the name of the Salina Canyon Coal Co.

The Sevier Valley Coal Co.'s holdings are located in the S. E. $\frac{1}{4}$ of sec. 20, T. 22 S., R. 3 E., approximately 18 miles east, by road, from Salina. Operations were started in 1924 and continued until 1932. Development work consists of a 200-foot reinforced concrete shaft and nearly 1 mile of underground workings.

The Salina Canyon Coal Co. started operations on the same vein approximately one-half mile north and 1 mile east of the Sevier Valley coal mine during the year 1926 and continued until 1930, when mining development ceased. The holdings are still controlled by the Boston Acme Co.

The Sevier bed (group of veins).—The Sevier bed is controlled principally by two parties, one, the Boston Acme Co., and, two, the Snyder Mines, Inc. No

mines are in operation at present but interest in the resin is keen and development is anticipated. The Sevier bed lies approximately 200 feet stratigraphically above the Ivie bed, and varies from 2 feet 6 inches to 8 feet in thickness, with an average of about $3\frac{1}{2}$ feet. This coal, like that of the Wilson bed is extremely high in resin. Selected samples may carry as high as 15 percent by volume.

The Snyder Mines, Inc., control ground in secs. 7, 17, 18, 20, and 21 of T. 22 S., R. 3 E. This includes the Livingston and Ivie property located in Coal Hollow, which is believed to also be under their jurisdiction. At the Coal Hollow mine, the coal bed is approximately 4 feet in thickness. The only reason a bed of coal of this thickness may be considered as a commercial deposit is due to the fact that it is overlain by a series of carbonaceous shales permitting proper tunnel height at a relatively low cost. This factor can also be credited to some of the other prospects on this bed and also the Wilson bed. Samples analyzed for resin, benzene (benzol) used as solvent, are as follows:

	Percent resin	Percent loss on extraction
Vein, 4-foot surface, high grade.....	11.3	11.3
Cross cut 75 feet from portal of tunnel.....	8.4	8.1

Source: Professor Kinney (analyst), University of Utah, Salt Lake City, Utah.

The Boston Acme Co. have 1,887 acres of patented ground in secs. 4, 9, 8, 16, and 17, in T. 22 S., R. 3 E. They have prospected the Sevier bed at a number of places and their showings indicate a similarity of the coal to those controlled by the Snyder Mines, Inc. The resin content and thickness of the bed, although variable, are characteristic of this vein. An average thickness of the bed is tentatively placed at $3\frac{1}{2}$ feet, but in places it is reported to swell to 6 feet, while in others it feathers down to a mere seam. Although the property was not visited by the writers, permitting the collecting of samples for analysis, Klemm reports a high resin content for the coal.

The Wilson group of veins.—The Wilson group of veins, or Wilson bed, is stratigraphically some 1,835 feet more or less above the Sevier bed and about 170 feet below the Castlegate sandstone. It represents the highest known commercial coal bed in the Salina district. The thickness of the bed varies from 2 to 6 feet. According to Lewis, this group consists of two workable veins, both of which are of significance because of their high resin content. George Wilson of Salt Lake City has 1,280 acres of ground under prospector's permit that covers secs. 10 and 15 in T. 22 S., R. 2 E. Samples were cut at the prospect located at the central and southernmost portion of sec. 10 T. 22 S., R. 2 E. These, analyzed for resin, benzene (benzol used as a solvent, are as follows:

	Percent resin	Percent loss on extraction
Surface high grade.....	14.9	14.2
Crosscut 3 feet 6 inches, 75 feet from portal of tunnel.....	6.6	6.4
Special lump taken 150 feet from portal of tunnel.....	6.5	6.3

Source: Professor Kinney (analyst), University of Utah, Salt Lake City, Utah.

List of persons or companies controlling resin-bearing coals of Salina and Huntington Canyons, Utah:

HUNTINGTON CANYON

1. American Fuel mine, American Coal Co., Salt Lake City, Utah.
2. Byron Howard mine, Byron Howard, Huntington, Utah.

SALINA CANYON

1. Wilson holdings, George Wilson, Salt Lake City, Utah.
2. Boston Acme Co. holdings, Emil Klemm, Salt Lake City.
3. Snyder holdings, Snyder Mines, Inc., Salt Lake City.

4. Sevier Valley Coal Co. holdings, Sevier Valley Coal Co., Richfield, Utah.

A comparison of the resinous coals of Salina and Huntington Canyons is summarized as follows:

Huntington Canyon: (1) Thick bed or seam, 14 to 15 feet, (2) lower resin content average at least 3 percent.

Salina Canyon (Wilson and Sevier beds): (1) Thin beds or seams from 2½ to 6 feet, (2) high resin content, average approximately 8 percent.

The resin in Huntington Canyon coal could be economically recovered only by salvaging the resin from the byproduct coal fines or bug dust. This material showed a resin content of 7.8 to 8.87 percent. Perhaps the 1-inch slack could also be utilized. On the other hand, the Wilson and Sevier beds of Salina Canyon would have to be mined primarily for the resin content. Although, because of the thin nature of the beds, mining conditions would not be as economical as in Huntington Canyon, the high resin content plus the much richer resinous coal fines that would be obtained in mining, illustrates the importance of the Salina area for resin. It is not the purpose of this report to suggest the better area from which to obtain resin, but it may be stated that both have favorable aspects.

Senator MURDOCK. We will now hear from Mr. Robert S. Palmer, executive secretary of the Colorado Mining Association.

**STATEMENT OF ROBERT S. PALMER, EXECUTIVE SECRETARY,
COLORADO MINING ASSOCIATION, DENVER, COLO.**

Mr. PALMER. My name is Robert S. Palmer. I am secretary of the Colorado Mining Association. It seems to me the situation in Colorado has been very ably and carefully covered. The mining associations of our State have a great many members who are hoping to be engaged in the production of shale oil. For that reason, primarily, we are concerning ourselves in helping present such evidence and studies as the members have accumulated over the years. A great deal of money has been spent on experimental work in the State of Colorado on oil shales and, of course, on coal. The association is very anxious to assist in every way possible in the development of the natural resources not only of our State, but the other States in this immediate area.

I would like to put in the record, if I may, our opposition to the bill which was mentioned, S. 1139, which has to do with the withdrawing of claims—oil shale claims—and placing them back into the jurisdiction of the Interior Department.

I don't think I should take any more of your time right now. If there are any questions that you have, I would be more than happy to answer them.

Senator MURDOCK. Are there any questions?

Mr. PALMER. I would like to add this: It is the general consensus of our members that we have a great deal of confidence in the members of this committee.

Senator O'MAHONEY. That is a very complimentary statement.

Mr. PALMER. Thank you. [Applause.]

Senator MURDOCK. Is Mr. R. S. Collett here, or is Mr. L. P. Anderle present?

Mr. ANDERLE. Present.

STATEMENT OF L. P. ANDERLE, SECRETARY, SAND WASH MINING
CO., MYTON, UTAH

Mr. ANDERLE. Mr. Chairman, Congressional guests, ladies and gentlemen: I am L. P. Anderle, of Myton, Utah. My associates and I compose a company called the Sand Wash Mining Co. which owns a small tract of oil shale land on Green River, and therefore we are very interested in this bill.

The potential value and size of the oil shale industry is enormous and runs into astronomical figures, and to get it going resolves into the ability of the industry to reduce the costs, principally in the extracting of the products.

I want to make a point which I think is overlooked. According to good authority there will be about 25,000,000 without jobs after the war is over. The oil shale industry could absorb a large number of that unemployment if it was functioning, even on a small scale.

I and my associates heartily endorse this bill, only we think it does not go far enough. We think there ought to be a number of plants or field laboratories established.

We, in a small way, made a number of tests and analysis, years ago, that were astounding. However, we did not have the equipment nor the time, nor the money, to follow those experiments and tests through. So we would like to see a plant established at the edge of the naval reserve, approximately at the junction of the Green River and Minnie Maude or Nine Mile Creek.

I wish to explain that oil shale is a side issue with me. I belong to that class designated last year as profiteers—the dirt farmers of America. No doubt the dirt farmers were profiteers—after we, and the members of our families, worked 80 to 86 hours a week and got 115 to 120 percent of parity against others who get 250 to 300 percent of parity. So, if nothing is done with this bill, it will not affect me very much; I will still keep producing more with less.

Senator MURDOCK. Senator Miller, we will now hear from you. State your name for the record.

STATEMENT OF GEORGE M. MILLER, UTAH STATE SENATOR, OF
PRICE, UTAH

Mr. MILLER. Senators, Congressmen, ladies and gentlemen. My name is George M. Miller, and I live in the great coal region of the State of Utah and, as the State senator from Carbon County, I endorse this bill 100 percent. I believe I might say, without any degree of extraordinary pride, that when I endorse this bill I represent at least 90 percent of the 25,000 people who live in Carbon County.

Now you have noticed during this meeting that there are peculiarities in each locality, and I was very forcibly impressed with the information or suggestion made by the manager of the Bureau of Mines, of Colorado, who suggested to this committee that this work of finding out the best processes for the production of oil from coal be divided according to the locality of each of the several districts. You can see, of course, that in Utah we want coal developed, and we want smokeless fuel. I apprehend, from what the gentlemen from Colorado say, that they want oil shale developed, because oil

shale to them is a great product, the product that will furnish to them the greatest development.

Now, gentlemen, we have in Utah a little county, called Carbon County, that is situated in the center of all this great potential shale oil and coal oil and rock asphalt and oil sand. We have a community down there that would extend to the people of this State, to the representatives of the Government, and all, fine cooperation. And I ask that the record show that the people of Carbon County respectfully ask that the first plant be established in Carbon County. I thank you. [Applause.]

Senator MURDOCK. This completes the list of witnesses that were on the schedule, as I have it. Before turning the meeting back to Senator O'Mahoney, I desire to say this, that I think the State of Utah and the people of Utah have been highly honored by the chairman of this subcommittee, Senator O'Mahoney, of Wyoming, by bringing this hearing to our State. [Applause.]

We have had with us from the Bureau of Mines and other departments in Washington, some of the finest experts in this line, I think, that you can find in this country or in any other, and we are honored to have them here with us. Congressman Randolph, of West Virginia, is doing a similar work in the House of Representatives, and agreed to come along with us, and I know that we have all been highly pleased to have him here with us, as well as Congressman Rockwell, from Colorado, our sister State. Senator Chan Gurney is one of the outstanding Republican Senators. He is from South Dakota. He has added greatly, I am sure, to the hearing here in Salt Lake City and elsewhere.

Senator Joseph C. O'Mahoney, of Wyoming, is looked upon by all western Senators as a man who thoroughly understands western problems, and in this matter and many others, we follow his leadership and, in my opinion, it is a real leadership.

I thank Senator O'Mahoney for doing me the honor of allowing me to preside during the afternoon, and now I turn the meeting back to him.

Congressman RANDOLPH. May I be indulged a statement?

Senator O'MAHONEY. Certainly.

Congressman RANDOLPH. During my service in Congress, I have had the opportunity of knowing and cooperating with western Senators and Representatives. The reason I say western Senators is, because after all legislation is a business and takes the form of a compromise between the Houses. Senator Murdock and myself came to Congress in the same year and then, of course, he was elevated to the other body. I served since 1933 with your own Representative, Congressman J. Will Robinson. I have come to know also Congressman Granger and Congressman Rockwell.

Before leaving Salt Lake City this evening, I should like the record of this hearing to show that through Senator O'Mahoney, Senator Murdock, Senator Gurney, and the other men of the West, I have come to value highly the vision and the virility of the type of representation that you send to Washington; and here in this city, at the cross roads of the West, I have learned also the cordiality of the people as a whole. [Applause.]

Senator MURDOCK. I have one very important statement that I want to make. It is this: At our hearings here we have had the most splendid cooperation that any committee of Congress could expect from your Governor and from his very efficient and capable committee, known as the Department of Publicity and Industrial Development of Utah. Mr. A. S. Brown, who is chairman of that department, is cooperating with the Congressional delegation of Utah daily, and whenever we call on him to do anything—like arranging meetings of this kind, or a trip like we had yesterday—he does it in a very splendid way. The Chamber of Commerce of Salt Lake City, under the presidency of Mr. Knickerbocker and the very efficient secretary, Mr. Bachman, has cooperated in every way possible, and I am sure has added greatly to these hearings and especially to the entertainment.

Mr. DOWNING. We of Colorado would be very happy indeed to go almost to the ends of the earth to attend the meetings for the purpose of supporting the work undertaken by the Senator from Wyoming. Consequently, we are very happy to come to Salt Lake City. We are happy to be here, and I don't know any place we would rather go than to Utah.

Senator GURNEY. Those in the audience today will remember that I have kept very quiet while you folks of the mining areas have been presenting the advantages of the minerals, coals, sands, and what not, and shales of your area here. I want to compliment you on the way you have presented the advantages of the different materials you have out here. As I see it, from attending the different hearings over the past few years, this is not going to be something that is going to spring up overnight like a mushroom and take care of all of our troubles. Making gasoline out of coal and oil is a long-time program; you can't expect it to come in sufficient size to take care of our demands for petroleum. I would say, even though we put all our energy and resources in it for over 30 or 40 or 50 years, it will be a supplemental process that will come in and supplement our supply of crude petroleum at present. A little further along, we will get gasoline from oil shale and natural gas; then will come our coal and what not. But we do have to have the know-how. We have some who know how now, but we have to know a lot more about it; and that, of course, is the purpose of this bill.

We want to remember, too, in taking minerals from the ground they are not replaceable. There are other sources of motor fuel, viz, those coming from the replaceable products of the farm, from the top 12 inches of soil. So there are other sources of motor fuel than just from under the ground. I am thinking now of alcohol made from farm crops. And that, in addition to giving the mining men a market for that which they have, it will also give the farmer an increased market for that which he raises. All these problems have to be studied. I think that in the final analysis there will be small plants dotted over the country, in order to give an f. o. b. price in each locality, where we don't have to figure transportation too greatly.

Certainly, I feel that our Government should go into this matter quickly and as thoroughly as possible. And be assured that the Government does not in any way intend to take over the business of private industry, but should and must incorporate in this bill the making of every bit of information obtainable available for industry.

I am glad to be with you. I feel I am from the Middle West and this is really the West. I have thoroughly enjoyed attending this meeting today.

Senator O'MAHONEY. I am happy that the members of the committee have taken the opportunity to express their appreciation of this hearing.

Like the others, I feel that this session today in the Hotel Utah has been of the utmost significance. You have been not only patient, but you have been interested in your attention to what the witnesses have said, and the witnesses without exception have contributed valuable information to the committee. It is impossible to believe, where such intelligent attention is being given by the people to the problems of the future, that we shall not be able to overcome them.

Yesterday, as one of the guests of Mr. A. S. Brown and the Chamber of Commerce on the tour to the steel plant at Geneva, and to the marvelous workings of the Utah Copper Corporation, I was tremendously impressed by what I saw. It seemed to me that here were two illustrations of what we must expect to do in the future. In the first instance, the Utah Copper Co.'s enterprise is demonstrative of what intelligent organization can do. The engineers and geologists out there told me that 600,000,000 tons of earth, material, and ore have been moved in this tremendous mining enterprise. There in that pit, we saw almost 140 miles of railroad transporting that ore, and yet it is a low-grade ore. I was told that most of that ore is well below 1 percent in copper; when the enterprise began, ore which was running less than eight-tenths of 1 percent was thrown away. Now, to be thrown away, the ore must be less than four-tenths of 1 percent. That enterprise has advanced; their recovery has been increased.

At the plant of the steel company, we saw an enterprise costing \$180,000,000. It would have been impossible if the Government had not made that money available; there was no other way under heaven that the production of steel for the defense of the Nation itself could be brought about except by the investment of Government funds. Now, here is an enterprise in Utah capable of tremendous production of steel. What are we going to do with it after the war is over? That is a question, the answer to which will have to be made by the public of Utah and of the country at large.

This is the significant thing to me about this whole enterprise: More than 50 percent of all of the goods and services that are now being produced and rendered in the United States are being supplied for the Government. Put it in another way: The Government of the United States is purchasing more than 50 percent of the total output of American ingenuity, American energy, American labor. It is doing it for the war. When peace has come and the Government is no longer purchasing that product, what is going to take its place? Obviously, if we are to keep the economic system running, we have to find a way of substituting for the Government, as the purchaser of the output, all of the people of the United States. That is why it is necessary for us to lay the foundation now for an expanding economy. That means planning. And when people talk disparagingly of planning, and of plans, I am reminded of the fact that was told me by the man in charge of the construction of the steel plant out at Geneva yesterday—more than 18,000 blueprints have been

prepared for that plant. It requires a library to catalog and file those blueprints. And, in addition to that, each blueprint requires countless numbers of other detailed papers explaining what the blueprint means. It seems to me this is an illustration of the sort of organization that is necessary if we are going to successfully supplant the Government as a purchaser of economic output by the people of the United States. And this bill, to which you have contributed so materially in your evidence today, is just one step in that direction; it is intended to create the opportunity for new industry which will go on after the war, industry which will furnish employment and profit for the people of the West and of the United States. We are most grateful to you for your presence here today and feel that we have been instructed. [Applause.]

(Session closed.)



SYNTHETIC LIQUID FUELS

WEDNESDAY AUGUST 11, 1943

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON
PUBLIC LANDS AND SURVEYS,
Sheridan, Wyo.

The War Mineral Subcommittee of the Committee on Public Lands and Surveys of the United States Senate met, pursuant to call, at 9:30 a. m., August 11, 1943, in the lodge room of the Elks Club, in the city of Sheridan, Sheridan County, State of Wyoming.

I present: Senator Joseph C. O'Mahoney (chairman of the subcommittee); Senator Abe Murdock, of Utah; and Senator Chan Gurney, of South Dakota. Also present were Senator E. V. Robertson, of Wyoming, a member of the Senate Committee on Public Lands; Congressman Frank A. Barrett, of Wyoming, a member of the Public Lands Committee of the House of Representatives; Michael W. Straus, Assistant Secretary of the Interior; and W. H. McMains, clerk of the Senate Committee on Public Lands and Surveys.

Senator O'MAHONEY. The meeting will please come to order.

If the gentlemen will be good enough to take their seats, we will proceed with this meeting.

As you may probably have learned from the dispatches published in the press, this is a subcommittee of the United States Senate, representing the Senate Committee on Public Lands and Surveys. It has been accompanied, until now, by some members of the Committee on Mines and Mining, of the House of Representatives, under the chairmanship of the Honorable Jennings Randolph, Congressman from the State of West Virginia. Congressman Randolph had an engagement at San Francisco, which made it necessary for him to leave the subcommittee at the conclusion of the session which we held in Salt Lake City, so that he will unfortunately not be able to be with us here. He has, however, sent a message, which the clerk of the committee has just handed me.

Mr. McMains, would you be good enough to read the message from Congressman Randolph.

Mr. McMains. It is addressed to Mr. Art Sherwood, secretary of the Chamber of Commerce of Sheridan.

Regret exceedingly my absence from hearing in your city. Senator O'Mahoney's legislative proposal lays the ground work for a vital war industry and a post-war development of great possibility. It is gratifying to have his leadership in this field. I am happy to cooperate.

JENNINGS RANDOLPH.

Senator O'MAHONEY. Congressman Randolph served on a committee in the House of Representatives studying the utilization of coal and other minerals for the manufacture of liquid fuel, plastics, and other materials of value to our economic system. He has displayed a great deal of interest in this matter, because, of course, West Virginia, like Wyoming, Montana, Utah, North and South Dakota, and other Western States, has large deposits of coal.

We held 2 days of session at Washington. There the Secretary of the Interior appeared before the committee and emphatically endorsed this legislation. Representatives of some of the large oil companies of the country appeared at that hearing, and likewise endorsed the proposal. Mr. W. Jett Lauek, economist for the United Mine Workers of America for the last 20 years, appeared at our Washington hearing and testified in favor of this bill. At Pittsburgh we had a very large meeting, attended by representatives of the Governors of the three States in that area which are interested in coal and its possibilities. The Governor of Pennsylvania, the Governor of West Virginia, and the Governor of Ohio—each of these States were represented by their State geologist, or by the person who spoke in that capacity. The universities and schools there were represented. And without exception, the principle of the legislation was endorsed. Indeed, some members of the committee wondered it if would not be a good idea to offer up a little opposition, everything seemed to be so harmonious. But to date, we have not succeeded in doing that. Today, I am on my own home stamping ground. The Governor of the State of Wyoming is represented by Dr. Thomas, the State chemist. The Governor of Montana is represented by the president of the Montana School of Mines, Dr. Thomson. The State of North Dakota is represented by Lieutenant Governor Holt.

Of course, the members of the committee here are known to all of you: My colleague, Senator Robertson, of Cody; Congressman Frank Barrett, of Lusk; the members of the committee itself, Senator Murdock, of Utah, who boasts about the Utah coal; and Senator Chan Gurney, of South Dakota, who boasts of the Dakota coals, and alcohol made from agricultural commodities.

I am very happy today to present the representative of Secretary Ickes, Secretary of the Interior Department, Hon. Michael Straus, Assistant Secretary of the Interior. Mr. Straus has been with us from the beginning of these hearings. He speaks for the Department of the Interior. He and his committee have contributed materially to the successful working out of these hearings. He will now talk to us briefly about the work that the Department of the Interior is doing.

Then will follow representatives of the Bureau of Mines, which is the agency of the Government in direct charge of minerals. I am prompted to remark here, Dr. Sayer, who is Director of the Bureau of Mines, we learned yesterday, when we visited the Monarch coal mine, came to Sheridan County more than 25 years ago with one of the mine rescue crews. When we were going through the mine yesterday, he met at least three miners who took the examination he gave and who successfully passed it 25 years ago, in safety work. He was delighted to meet these men, and I know they showed every evidence of being very happy to have met him again.

Secretary Straus, will you be good enough now to take the stand, and make your statement.

STATEMENT OF HON. MICHAEL STRAUS, ASSISTANT SECRETARY,
DEPARTMENT OF THE INTERIOR

Mr. STRAUS. Mr. Chairman, and members of the committee, Senator Robertson, Representative Barrett, and all the public officials of this area who are here, I am delighted at this opportunity to be the first witness at the end of this long trip that we have had. We have had a good deal of education during this trip, and Sheridan, Wyo., began looming up on the horizon as soon as we got out of Washington. I want to tell you an incident that happened in our first public meeting at Pittsburgh, which sort of made this the interest of the end of the trail. We had a big meeting in the Bureau of Mines station at Pittsburgh. I don't know how our chairman contrived some of these things, or how he makes other people do them, but Dr. Storch, principal chemist in the Bureau of Mines, was on the stand, and he ran off about 10 years of tests on coal, to see which coals are the best ones from which to get oil. Both the Senators of Pennsylvania and a number of Representatives were sitting with Senator O'Mahoney, and in due course, one of the Pennsylvania delegation asked Dr. Storch which coal is the best to make oil. Obviously, the answer ought to have been the Pennsylvania seam. That is the reason the question was asked, because the Pennsylvania seam is very well thought of in Pennsylvania. Dr. Storch replied "the Monarch coal, mined in Sheridan, Wyo." That was about 2,000 miles away. We have had a good deal of education since then.

Mr. Chairman, the Department of the Interior is known in this country, principally as a western department, because of the activities of the Bureau of Mines, the General Land Office, the Grazing Service, the Office of Indian Affairs, and other agencies. But since the war, there have been additional responsibilities imposed on the Department. Two of them have a direct bearing on this legislation, because we serve as Petroleum Administrator for War, and Solid Fuels Coordinator for War. It was in connection with the oil administration that the situation first became dramatically emphasized. Now, this year, the Petroleum Administration for War, made its first national comparison of our oil discoveries and oil depletions, and found in the United States for the year 1942, last year, that our new discoveries of oil, added to evaluation of domestic reserve, were only 57 percent of our depletions of oil. That meant that we're going on a downgrade. Not only that, but our depletions have increased. Our United States is virtually fueling this war, and fueling all our allies in this war. We do not seem to be able to meet the situation from wildcatting and an increased search for oil, although a survey for oil is going on in this country that has never been equaled. I have a couple of figures; in 1937, nationally, there were 2,224 wildcat wells drilled, and they found over 2,000,000 barrels of oil. Last year, 5 years later, there were half again as many wildcat wells sunk, 3,045, and they found only about half as much new oil as was found 5 years previously. We are looking at the bottom of the oil barrel and the natural petroleum shortage is starting in this country right now. In my State of Illinois, I know of refineries closed down because they cannot get crude. I think the same thing may develop in other States. The best opinion we have been able to get, and that has been elicited by

Senator O'Mahoney's hearing in other States, is that there are 14 to 15 years' supply of oil left in this country, at our present rate of consumption, which is an increased rate. But we could not get that oil out of the ground in that period. It would take about half a century to recover that oil under the present systems of recovery. That is the background, the unhappy background with which we approach this legislation. But there is a silver lining to it, because we have other sources of liquid fuel, and they are synthetic sources. There are three of them. There is natural gas, which is quite usable, but the supply is very limited. Geologists, and Standard Oil representatives, and others, have testified if we use natural gas—a very valuable resource in itself as gas—to make gasoline, maybe we might get a 2- or 3-year supply of synthetic liquid fuel, and deprive ourselves of that valuable gas that we can use in many other forms. So there isn't very much hope there.

Another source, a second source, is much more hopeful; that is oil shale, which we have in quantity, in this area, Colorado and Utah. The Bureau of Mines has made gasoline from oil shale, made about 3,000 barrels of it, experimentally, in a plant that it had in Colorado. Three thousand barrels may sound like "some oil" to us in this day of A coupons, but it is only a drop in the bucket compared with the amount needed. However, there is a lot of shale. We know of no other use for it, and there is sufficient shale to supply our present liquid fuel needs for 65 years or more, according to our best knowledge of existing reserves. There is a big opportunity for us in this oil shale, which is one material fully covered by this bill. However, we will hear a good deal more about oil shale later today.

However, there is another source that is even more plentiful. That is coal. The Bureau of Mines has been anticipating a depletion of natural petroleum reserves, and has erected and operated, in Pittsburgh, a plant that has actually obtained gasoline from coal. And we have plenty of coal. The Geological Survey of my department reports that there are known coal reserves in this country of 3 trillion tons, not million, not billion, but if you have sufficient quantity of ciphers left, 3 trillion tons, which at the present rate of consumption of coal, as coal, would last us about 3,000 years. We can use that to make synthetic gasoline for about 3,000 years and leave enough coal over to meet all our normal coal demands, as we use coal now. So we don't need to have any violent repercussion in our way of life and our national economy, if we can move fast enough to meet this situation. And we are late now; we are quite late.

There are many questions that come up in connection with this legislation, only two of which I wish to comment upon. It is not proposed—it is not the philosophy of the Department of the Interior, that synthetic gasoline should compete, or will shortly be in competition, with natural gasoline. The price, which probably will come down, is still too high. It is 12 to 20 cents a gallon. But the philosophy is that we can have, if we are smart enough, synthetic gasoline, when it is a question of synthetic fuel or no fuel.

It is also not the philosophy of the Department that there will be any competition with industry in this, because this proposal is to complete demonstration plants to get the knowledge necessary before this new industry can be established. We have done it in Pittsburgh, to be sure. We have got the gasoline, and those making the test

have driven cars powered by this gasoline. But that is a laboratory-sized plant, uses a hundred pounds of coal a day, gets a few gallons of gasoline a day. But it is a toy plant. It shows it is possible to make synthetic fuel, but it does not give us the answer to the economic problems, the answer to the transportation problems or the volume of production. That can only be secured through demonstration plants which the Government scientists can build, not for volume production, but as an individual plant or two that can be copied by industry. We believe they will be followed up so the Nation can get from private sources the fuel it needs to preserve our national economy. Mr. Chairman, I do not want to give any prepared statement, but I have looked into what has been done in other countries. Hitler is fueling this war on synthetic liquid fuel. More than half of the gasoline that runs his panzer divisions and Luftwaffe, are obtained from coal. Japan is making synthetic liquid fuel. We know that they are making it in considerable quantity, and they are not telling us all their processes. England is making a synthetic liquid fuel.

There is, in this area, a scientist from the Bureau of Mines, who recently flew to England and saw the great plant at Billingham, where they make gasoline from coal. They make enough of it to keep a hundred bombers over Germany day and night, which is a very good place to keep a hundred bombers. He got from the English full knowledge of their processes, and Mr. Chairman, the English will send their technicians over to help us when we are ready to proceed with this program.

There are a great many more competent technical witnesses here, and I will not give any technical testimony, but will defer to the western scientists and the Bureau of Mining people that are here. The Department is greatly encouraged by the vision represented in this bill you have sponsored, and by the reception in the various States where we have been. We see in this bill a start, and the opening of a door that may let us extend our gasoline supply that has been so advantageous to us, a hundred or possibly a thousand years. We see a distinct repercussion on American economy if we do not meet the situation caused by the exhaustion of our natural domestic petroleum reserves. The Department of the Interior, upon the passage of this legislation, is anxious and eager to get on with this job, which we feel is already long overdue, and I am pleased to be authorized to state here that this legislation has the unqualified endorsement of all powers and scientific agencies of the Department.

Senator O'MAHONEY. I know that the Governor of South Dakota is represented here by Dr. E. L. Tullis, geologist for the South Dakota School of Mines. And he is accompanied by Dr. J. P. Gries, geologist of the same school. I want to say to the representatives of the Governors of these surrounding States, and to the State geologist of Wyoming, you may feel at liberty to interrupt any of the witnesses, and to ask any questions that occur to you, as the testimony proceeds. Of course, it goes without saying, our colleagues, Senator Robertson and Congressman Barrett are likewise free to ask any questions that may suggest themselves to them. Senator Gurney and Senator Murdock have been living with this bill for some time, and it is quite likely they won't think of all of the questions that come to your minds, since this is the first time you have had an opportunity to discuss this bill or to hear the testimony of the men who will appear. So with

that introduction, I now ask: Are there any questions to be submitted to Secretary Straus? If not, we will call the next witness, Dr. Sayers, Director of the Bureau of Mines.

**STATEMENT OF R. R. SAYERS, DIRECTOR, BUREAU OF MINES,
DEPARTMENT OF THE INTERIOR**

Dr. SAYERS. Mr. Chairman, members of the committee, Senator Robertson, Congressman Barrett, ladies and gentlemen, The Bureau of Mines, as you know, is very much interested in this bill, and I am interested particularly in the beneficial effect it can have on the mining industry over the United States. I have been associated, as many of you know, with mining, for a period of more than 25 years. as stated by your chairman, I had the opportunity and satisfaction of being in this district more than 25 years ago. It has been a pleasure to come back to these mines and find some of the personnel I met at that time. I was impressed here and in Utah with the ingenuity and application of new ideas in the mining industry. This is especially true of the Monarch mine which we visited yesterday, where large amounts of coal are being produced by highly mechanized mining methods. These applications have unquestionably reduced the cost per ton of coal.

You heard Secretary Straus say that the cost of gasoline from coal would probably be greater than the cost of gasoline at a refinery today, perhaps two or three times as much. That does not mean we will not be able to reduce these costs through the development of new methods and the application of new ideas just as they have been reduced in coal mining. Secretary Straus also mentioned the use of oil shale. He told you that the Bureau of Mines, a number of years ago, produced about 3,500 barrels of gasoline and oil from shale. That did cost us more and would cost us more than liquid gasoline or oil from petroleum. We did that work from 1926 to 1929, in the State of Colorado. New methods of mining and new methods of extracting the oil from shale could reduce the cost considerably. It is desirable for the Bureau to reopen its investigation in this field.

Discovery of new pools of petroleum has not kept pace in the last 5 years with the rate we have been using petroleum. It would seem that we need to look for other sources for our gasoline and oil. These might be oil shale, oil sands, or coal. It is estimated that reserves of shale are sufficient to supply our present demand for 65 years. Known reserves of oil sands in the United States are limited but in certain areas they may well be worth exploitation. Coal reserves are sufficient to supply our present consumption of oil and gasoline and fuel for combustion for at least 1,000 years.

Coal can be converted to liquid fuel by two different processes. The first places the coal in contact with hydrogen gas under high pressure and under suitable conditions a chemical reaction takes place that converts the coal to a liquid, similar to petroleum. From this liquid a high octane gasoline and oils can be produced. In this second process synthetic fuels are obtained by breaking the coal down to produce carbon monoxide, and hydrogen, and then recombining these gases to form synthetic petroleum, which can be distilled, and cracked to make gasoline or other substances. You can make lubricating oil and waxes. You can make greases, if you care to do

so. Those things can all be accomplished. In spite of the large amounts of coal we have in this country, however, work done on these processes has been very limited.

The Bureau of Mines started investigation in 1936 on the first or hydrogenation process for converting coal to oil. The second process was studied briefly in 1929 and the investigation reopened in the later part of 1942. At the present time there are a number of factors that impinge upon the cost of the production of fuels by these methods. It is for the study of those various factors that this bill is proposed which authorizes the Department of the Interior to undertake through the Bureau of Mines, this study of various raw materials and methods for producing synthetic gasoline and oil.

The President, in his speech, stated on July 28, that in the missions over Sicily, each bomber used 1,100 gallons of high-octane gasoline. If we consider keeping a thousand bombers over Germany every night for a month, we would have to stop every automobile, airplane, tractor, and internal combustion engine in the United States for 24 hours. Think what that would mean to us. It seems that the need is here, as Mr. Straus stated; it is already late. We don't want another crisis similar to the one we had in rubber. We thought we knew how to produce synthetic rubber, but it was soon found when we started to build plants, that we did not have full information about either the economic or engineering factors.

Senator O'MAHONEY. Are there any questions?

Senator MURDOCK. Section 3 of the bill, Dr. Sayers, reads as follows:

The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property required, but in his opinion no longer useful, for the purposes of this act, and to grant, on such terms as he may consider appropriate, licenses under patent rights required under this act.

I read that section of the bill, which is section 3, because of some apprehension on the part of some people, that it is intended by this bill to bring the Government into competition with private industry. If the bill is passed, the functions of the Government under it, will largely be under your supervision. Would you care to comment at this time on that section of the act?

Dr. SAYERS. It has not been the thought of the Bureau of Mines, or the policy of the Department, as expressed repeatedly by the Secretary, to enter into competition with industry. This bill is to establish demonstration plants and to develop the best methods for the use of industry. It is believed that we cannot expect industry, at this time, to undertake the studies that are necessary for any returns on such an investment for they may be long delayed. Therefore, if the work is to be done before it is too late, the Government must do it. It is not intended that this be competitive with industry in any way.

Senator MURDOCK. If the bill is passed, and I am quite sure it will be, will it not be the purpose of the Bureau of Mines to be helpful in every way possible to private industry?

Dr. SAYERS. Yes; and we would like them to cooperate with us.

Senator MURDOCK. At our former hearings, that intention on the part of private industry was rather emphatically expressed.

Dr. SAYERS. It has been expressed over many years in our association with industry.

Senator MURDOCK. I believe this committee, and yourself, as Director of the Bureau of Mines, and Mr. Straus, representing the Secretary of the Interior, will assure the people here this morning, and who have read in the papers about this hearing, that there is absolutely no intention on the part of the Government to compete with private industry.

Dr. SAYERS. That is true, sir.

Senator GURNEY. Doctor, after this bill is passed and becomes a law, what will be the Department's recommendation as to the amount of money that should be appropriated to build these demonstration plants?

Dr. SAYERS. There will be probably be three plants, atleas tthree plants have been recommended, representing three different processes, one for oil shale, one for synthetic fuel, and one for hydrogenation. They will vary in actual cost depending both on the process used and the size of the plant. A rough estimate of the total expenditure over a period of several years would be from thirty to fifty millions of dollars to secure the needed information. This is a very small amount of money for the security of the people of the United States. I would visualize that the Bureau would continue its work for a period of years, increasing our knowledge, making the changes that are necessary for development. Ultimately, however, various parts of it would be taken over by industry, so it would pass out of our hands and go into the hands of industry for operation.

Senator O'MAHONEY. What size plant do you have in mind at the present time?

Dr. SAYERS. It varies with the different types of work we do, from a few hundred barrels to a thousand or fifteen hundred barrels a day. To obtain the economic cost and engineering data for some of the processes may require a plant with a capacity of from a thousand to fifteen hundred barrels a day. For other processes, a plant of a few hundred barrels a day will give the information. All we want to do is build the simplest plant that will give us the economic, engineering data and scientific data.

Senator O'MAHONEY. Why is it necessary to invest such a large amount of money in these plants?

Dr. SAYERS. The plants that cost the most money, are those that require high pressure and high temperatures, and you cannot get your information on those very high pressures and high temperatures without using equipment of the size that would be used in a commercial plant. It takes good material, and good equipment to produce those high pressures, and that kind of equipment is expensive.

Senator O'MAHONEY. In other words, the machinery which is necessary to construct and operate a plant is expensive machinery, obtainable only with considerable difficulty?

Dr. SAYERS. That is correct; sir.

Senator GURNEY. This estimate of cost will include not only buying the site, building the plant, but also the cost of the equipment, and will also include money to pay the salaries of the personnel?

Dr. SAYERS. That is correct, sir.

Senator GURNEY. You say the maximum output of 3 or 4 demonstration plants will be possibly 1,500 barrels per day?

Dr. SAYERS. That may be the size of 1 plant, and the other plants might be a hundred barrels per day. They might run to 500 barrels per day per plant.

Senator GURNEY. These plants would not operate continuously?

Dr. SAYERS. Not necessarily, but to obtain costs, you have to operate them continuously for a sufficient length of time.

Senator GURNEY. Doctor, what I am trying to get at is this: that the type of these plants could not, by any stretch of the imagination, produce as much as 20,000,000 gallons of gasoline, in a year?

Dr. SAYERS. Not even remotely.

Senator GURNEY. That would be, in comparison with our national consumption, at the present time, a small fraction of 1 percent of our national consumption?

Dr. SAYERS. A very small fraction.

Senator GURNEY. We are now consuming at the rate of one and four-tenths billions of barrels per year, at the present time. That was the purpose of my question.

Dr. SAYERS. It cannot be considered competitive in any event.

Senator ROBERTSON. You have mentioned here, liquid fuels and gasoline. I am not acquainted with the processes under which this is actually obtained. In the course of that process, is there any lubricating oil obtained?

Dr. SAYERS. Yes; lubricating oils can be produced, if so desired. You can produce waxes. You can produce greases, lubricating oil, heavy fuel oils, Diesel oils, almost any of them you want, by changing the conditions of the catalysts.

Senator ROBERTSON. My question was prompted by the bombing of the fields in Rumania, and that they supplied Germany with lubricating oil, rather than gasoline.

Dr. SAYERS. According to the data we have, Germany will feel the need of gasoline from Rumania, which supplied about one-half, and produced about one-half of the gasoline and oil available to Germany. You take one-half of their gasoline and it hurts very materially. In 1939, the data available to us showed that the synthetic fuel being made in Germany was about 25,000,000 barrels. That has been very greatly increased. The output at Rumania was about 45,000,000 barrels, according to our last data. You hurt them in destroying the source of gasoline, as well as lubricating oils.

Senator O'MAHONEY. Senator Gurney has made a little computation here and passed it on to me, which would indicate the plants you have been talking about would manufacture not more than one-three-thousandth of our normal need.

Senator GURNEY. Might manufacture.

Mr. D. H. PAPE. I understood someone to say 600,000 barrels a year.

Senator O'MAHONEY. At the present moment, the record shows our present consumption amounts to 1,400,000,000 barrels of petroleum. Of course, that is by reason of the large increase due to the war.

Senator GURNEY. I might give you something to compare it with. In about 1935 or 1936, as I remember the figures, we were consuming about 17,000,000,000 gallons per year, and at the present time, it

figures out about 58,000,000,000 gallons per year, or a little more than three times as much as we were consuming 6 or 7 years ago.

Senator O'MAHONEY. Are there any other questions?

Mr. PAPE. In other words, the gasoline consumption represents about half of the crude, about 600,000,000 barrels?

Secretary STRAUS. I think for the sake of the record, 1,500,000,000 barrels of petroleum is a production figure, and not a domestic consumption figure. It is oil that is being produced domestically, now, from natural sources. At the present time, we are fueling the world.

Senator O'MAHONEY. It was my intention to make that clear. We are producing that amount of petroleum, and using it both in the war and for domestic purposes.

Secretary STRAUS. That is correct, sir.

Mr. PAPE. I want to clear up the gasoline consumption versus production, Dr. Sayers.

Senator O'MAHONEY. Governor Holt has the floor.

Lieutenant Governor HOLT. Is the liquid fuel obtained by hydrogenation of coal, the full equivalent of natural petroleum?

Dr. SAYERS. We can make each of the products that we desire that come from our petroleum. We can make high octane gasoline, Diesel oil or fuel oil. That is what our laboratory studies indicate. Dr. Fieldner is here; he can give you more information.

Mr. PAPE. May I ask Dr. Sayers, if under the present type of plant for the extraction of synthetic fuels, is not the cost for extracting from coal greater than the cost for extracting from oil?

Dr. SAYERS. It is greater, as indicated by Secretary Straus and myself, perhaps two to three times as much for the present state of development of the synthetic liquid fuel processes.

Mr. PAPE. I have in mind the plant and equipment, in the total cost of production; the cost of the plant and equipment; isn't it more complicated equipment?

Dr. SAYERS. It is, depending on the processes used, Mr. Pape. We can produce, and do produce practically a crude petroleum. You would go on and use that in the regular refineries, as they now exist. It would be another source of crude petroleum which would be supplied to the refineries.

Secretary STRAUS. May I supply a supplemental piece of information?

Senator O'MAHONEY. Certainly.

Secretary STRAUS. In consideration of this forward-looking bill the chairman has introduced, the Department conferred at considerable length with the industry, Petroleum Administration for War, including the refining group of the industries. They reported a very considerable amount of existent refining equipment could be used or modified, and also other oil handling equipment, especially transportation equipment, pipe lines, tank cars could be salvaged for use with this type of synthetic fuel. They also gave as their information to show the timing of this program, Germany took 20 years to get into quantity production. I am sure we are going to have a great many difficulties in getting into quantity production, but the Petroleum Administration for War is of the opinion, if this legislation passes and all facilities are made available to industry and Government, the know-how is at hand, we could not—this country—in 1 year could not produce the amount of gasoline it now consumes in one day.

Senator O'MAHONEY. Are there any questions?

Congressman BARRETT. In the experiments in Colorado by the Bureau of Mines, on shales, what was the cost of producing a barrel of crude oil down there?

Dr. SAYERS. Do you recall, Mr. Kraemer?

Mr. KRAEMER. I made an estimate at the hearings last October, of \$2 a barrel.

Congressman BARRETT. I assume on a quantity production it could be reduced considerably?

Dr. SAYERS. Perhaps that can be done.

Congressman BARRETT. What is the estimate that the Bureau has on the cost of extracting this synthetic fuel from coal?

Dr. SAYERS. It varies from \$3 to \$5 a barrel.

Congressman BARRETT. I was very interested, too, Dr. Sayers, in your slight reference to extracting the oil from sands. I assume you meant oil-bearing sands, where they outcrop?

Dr. SAYERS. That is correct.

Congressman BARRETT. Is there any great quantity of that in this country?

Dr. SAYERS. There is some in this country that needs further investigation. We are also investigating some known to be in Utah, and some in Wyoming.

Congressman BARRETT. Would it be simpler to extract oil from oil-bearing sand than from shale or coal, in your opinion?

Dr. SAYERS. I think there are so many factors that it is hard to give you a clean-cut answer. In some places, I think it might be about the same, and in others more difficult. For instance, I can recall a report—I did not see it—where they were extracting oil from oil sands at considerable depth. It was really a very difficult problem, and the cost of the engineering work was great. Where oil sands are close to the surface, it might be done with a power shovel. Then the difficulties would not be very great.

Congressman BARRETT. Don't we have some along the Black Hills uplift?

Dr. SAYERS. I don't know for sure. Maybe some of the geologists—Dean Dickinson—Dean Harrington, could you say?

Dean HARRINGTON. I can't answer as to the Black Hills.

Dr. TULLIS. I can say, no.

Senator GURNEY. May I put in a question that will make matters more clear? This bill before us is to build demonstration plants, so we may gain more knowledge, so that we can be better able to answer the questions that have been put to you just now. They have been asking you how much it costs to make gasoline out of coal and from our present knowledge, we have to say from \$3 to \$5 per barrel; is that right?

Dr. SAYERS. That is correct.

Senator GURNEY. And the purpose of this bill is to find out what it will cost to make gasoline out of coal, and to, if possible, gain more knowledge, more know-how, so that we can try to reduce the manufacturing cost; isn't that right?

Dr. SAYERS. That is correct, Senator.

Mr. PAPE. May I ask a question? The reason I am asking is I want to talk to the National Coal Association. I understood in our conversation with you gentlemen that the cost of refining from oil ranges from 5 to 6 cents?

Dr. SAYERS. That is the cost of gasoline.

Mr. PAPE. Now, on the other hand, the figures we have of the German processes, runs from 17 to 18 cents a gallon?

Dr. SAYERS. One of the processes; yes.

Mr. PAPE. Is it your definite opinion, through these plants, through the progress or research, that the 18 cents can be very materially reduced?

Dr. SAYERS. It may be possible to reduce the cost by the various methods.

Senator O'MAHONEY. I might add, at the hearings before the House Committee on Mines and Mining, of which Congressman Randolph, who unfortunately is not here, was chairman, W. S. Farish, then the president of the Standard Oil Co. of New Jersey, testified the research had given considerable thought and study to the German processes and to other processes for making oil and gasoline out of coal. It was the estimate of Mr. Farish to the House committee that gasoline could be made at from 12 to 20 cents, and I take it from what the experts have said that in their belief these demonstration plants will make clear that those costs can be materially reduced.

Mr. PAPE. Right along that line, there has been a great deal of hesitancy on the part of the coal industry to enter into this problem. I remember in 1926, at the national meeting of the board of directors of the National Coal Association, we were informed that the Standard Oil had secured the patent rights, and that has been a deterrent all these years. The time for the patent has about expired, and will that system be available, in your opinion, to the American coal industry?

Dr. SAYERS. Yes. As a matter of fact, we have very definite statements that the oil industry will be very glad to cooperate with us and make use of such patents available. Furthermore, you have called attention to the fact the patents have about run out. I believe they are out.

Senator O'MAHONEY. We are very grateful to you, Dr. Sayers, for your attendance. The next will be Dr. Fieldner, who is head of the Fuels and Explosives Division. Dr. Fieldner was sent to Germany several years ago by the Bureau to look over the German hydrogenation plants. The doctor was with us yesterday in the tour of the coal mine. I hope he has brought with him the sample of the mon-arch coal, to which was called his attention and that of his colleagues on the trip. Doctor, will you take the stand.

STATEMENT OF A. C. FIELDNER, CHIEF, FUELS AND EXPLOSIVES SERVICE, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR

Dr. FIELDNER. Mr. Chairman, members of the committee, guests, ladies and gentlemen: As you stated, Senator, I did have the great privilege of going to England and Germany and France in 1924 as an official representative of the Department of the Interior to the first World Power Conference held in London. After this conference, I visited the various coal research laboratories and the experimental plants for the low-temperature distillation of coal, of which there were a number in England and in Europe. As I will explain later, this process for the low-temperature carbonization of coal yields as a byproduct, tarry oils which can be further processed to yield fuel oil

and motor fuel. I visited low-temperature carbonization plants in Belgium, France, Germany, and Austria, and I visited also the coal liquefaction pilot plant, which the inventor of the process, Dr. Frederick Bergius, had in operation at that time at Mannheim, near Frankfort, Germany. Dr. Bergius was very cordial, and made no reservations in showing me this experimental plant, which was rather large—almost a demonstration plant. The units were large enough to give the same results as would be obtained in a commercial plant. His experiments were observed at the time I was there by engineers representing an English group of capitalists, who were considering the purchase of the rights to the process for Great Britain. Tests were in progress on English coals at the time of my visit.

Subsequent to my visit in 1924, Dr. Bergius and his group sold their patent rights to the so-called German Dye & Chemical Trust, commonly called the I. G. Farbenindustrie. The I. G. had been conducting parallel experiments to those of Dr. Bergius, and they were having conflicts on patents. They got together about 1927 and combined their interests. The I. G. took over and conducted further experiments and completed a commercial scale plant, which was put into operation about 1926 or 1927. The I. G. modification of the Bergius process was referred to at the second International Coal Conference held in Pittsburgh, Pa., in 1928 and described in greater detail at the third International Coal Conference at Pittsburgh in 1931. The Imperial Chemical Industries, Ltd., of Great Britain started an experimental hydrogenation plant which treated 15 tons of coal per day. After operating this pilot plant 2 years, this company designed a commercial plant which was completed at Billingham, England, in 1934. It has a capacity as designed of about 3,500 barrels of gasoline per day. It is based upon the patents of Bergius and the I. G. Farbenindustrie which Imperial Chemical Industries acquired for Great Britain. Subsequently, these patents were acquired for the United States by the Standard Oil Company of New Jersey. Through a subsidiary company, International Hydro Patents Corporation, these patents were made available to those oil companies that wished to use them in this country.

The Standard Oil Co. of New Jersey built a commercial plant in Baton Rouge, La., and another at Elizabeth, N. J., for hydrogenating heavy oils by this process, for making gasoline and certain lubricating products. This hydrogenation of heavy oil is essentially the second step of the Bergius coal-hydrogenation process. In the first step of the Bergius process powdered coal is mixed with very small amounts of catalytic materials, such as tin and iodine, and with an equal amount of oil, the oil being obtained from the process itself. Under the effect of heat and hydrogen at high pressure this paste of oil and coal is converted into crude oil, and this crude oil will yield some 30 percent of gasoline and 70 percent of middle and heavy oil of which about half goes to the second step of vapor-phase hydrogenation, and the remainder is used with coal dust for the first step of hydrogenation. American oil companies are employing the second step of oil hydrogenation in commercial plants, but no commercial coal hydrogenation as required in the first step of the Bergius process has been done in the United States. That problem was taken up by the Bureau of Mines, when money was appropriated and made available about 1936, for a small laboratory plant which can convert about 100 pounds of coal to 7 gallons of gasoline per day. This laboratory is in Pittsburgh, Pa.

It is operated under the immediate direction of Dr. H. H. Storch, for the purposes of assaying our American coals, ranging from high-volatile bituminous coal to subbituminous coal and lignite. The monarch coal of Wyoming was tested in that plant. My statement given at the hearing in Washington, D. C., gives the yields of gasoline from 14 different coals. The relative yields from these coals ranged from 63 gallons per ton of lignite to 110 gallons per ton of subbituminous coal and 135 gallons a ton for the best high-volatile bituminous coal.

Senator O'MAHONEY. You tested coals from all over the country?

Dr. FIELDNER. Yes, sir; all over the country.

Senator O'MAHONEY. From the Dakotas?

Dr. FIELDNER. Two samples from North Dakota lignite yielded 63 and 65 gallons respectively of gasoline per ton of lignite liquefied.

Senator O'MAHONEY. And Montana coal?

Dr. FIELDNER. We tested a sample of coal from the Rosebud bed near Colstrip, in Montana.

Senator O'MAHONEY. And from Utah?

Dr. FIELDNER. And from Utah we tested a sample from the Lower Sunnyside bed. This sample gave one of the highest yields of gasoline per ton of coal treated.

Senator O'MAHONEY. In other words, in the toy plant in Pittsburgh, which has a capacity of treating 100 pounds per day, you have tested all of the coals of the United States?

Dr. FIELDNER. We have tested representative samples of a number of types of coal, not all of them.

Senator O'MAHONEY. New Mexico?

Dr. FIELDNER. No, sir, we haven't run any coals from New Mexico.

Senator GURNEY. Could you read your list, Doctor, giving us the coal, the yield, and the State they come from?

Dr. FIELDNER. I would be glad to do so.

Senator GURNEY. I think that would be more informative.

Senator GURNEY. Mr. Chairman, may I be pardoned for putting a plug in for our Dakota mines? I want to develop mining costs, etc.

Senator O'MAHONEY. Certainly.

Senator GURNEY. Doctor, you know the different mines around the United States and elsewhere. What is your information on mining costs per ton of coal? I am thinking now of a mine that operated, not as efficiently as the Monarch mine we saw yesterday, but more hand labor. I think you said the Monarch mine was about the best mechanized mine you have seen. Now, what is the cost of bituminous coal in Pennsylvania, per ton, for just mining?

Dr. FIELDNER. I cannot give you that figure, because I don't have it. I don't have a report with me. I can supply them for the record, but perhaps some of the other witnesses, say coal mining men, might supply some figures.

Senator GURNEY. Let's get at it a different way then. It costs more to mine coal, where you have to go down deep for it?

Dr. FIELDNER. Yes, sir; strip mining is unquestionably much cheaper, in general, than underground mining. In North Dakota, where two-thirds of the production is strip mined the average value of the lignite per ton f. o. b. cars is \$1.27, whereas in West Virginia where strip mining is about 1 percent of production, the corresponding average value is \$2.23.

Senator GURNEY. Shall we say then that a great part of the cost of making gasoline from coal could be figured as mining cost?

Dr. FIELDNER. Not a great part, but an important part, probably of the order of one-fifth the cost of the finished gasoline. If the finished gasoline cost is 16 cents a gallon and the coal \$2 a ton, 3.2 cents would be the cost of the coal. In the Billingham plant, we could save half of the mining costs, and probably more due to our lower cost of mining, especially in strip mining. We pay our men more, but we use fewer men. We get more tons of coal per man than in England. They get an average of $1\frac{1}{2}$ tons per man, where we get an average of 5 tons per man for the United States as a whole.

Senator GURNEY. Supposing a barrel of fuel costs a dollar a gallon. We know it is more than that. Let us say 75 cents over and above the coal itself. Then by reducing the cost of getting cheaper raw material would reduce the cost only 25 cents?

Dr. FIELDNER. That is correct.

Mr. PAPE. At this time, I would like to ask for a correction here. I don't know whether you all recognize the fact that this is spreading over the country like wildfire; what you gentlemen are doing here is starting a change that is going to be of influence in the coal industry when the operators of the country know the Government is fully behind it, I think you will get the reaction. There is misleading information coming out. These figures Dr. Fieldner has just given here are entirely different from the figures given the newspaper. For instance, with Monarch coal, he shows 100 gallons to the ton, and the newspapers give 50 to 60. Now, the reason for that comes from the fact they are considering it takes 2 tons of coal to handle this. It doesn't give the net gallons cost from the extraction of 1 ton. The other ton is part of the operating cost in making that. If you are going to give out to the public you get only 50, then as a matter of fact you get a hundred, you are going to have a reaction you don't want.

Senator GURNEY. Isn't it a fact, in getting 100 gallons from a ton of coal, you use another ton to heat or process the original ton of coal?

Dr. FIELDNER. That is right.

Senator GURNEY. Therefore, in reality, you do get not 100 gallons, but 50 gallons of gasoline from 1 ton?

Dr. FIELDNER. Yes, sir. We get 50 gallons of gasoline per ton of total coal used for all purposes.

Mr. PAPE. But this way, you are using 2 tons of coal to a hundred gallons of gasoline?

Dr. FIELDNER. That is right. A hundred gallons is obtained in processing a ton of coal, the other ton of coal is consumed in providing power, steam, hydrogen, and heat for the process. It might be considered as an operating cost.

Senator MURDOCK. In the matter of costs, Dr. Fieldner, of course, mining is a factor, and many other things are factors in the ultimate cost, I take it from what you stated; further, that the oil content, or gasoline content of the coal is also an important factor?

Dr. FIELDNER. Yes, sir.

Senator MURDOCK. I call attention to that, by reason of the fact I find, in this statement, that the highest yield per ton of coal is from Utah coal, that you have mentioned, 136 gallons per ton. Now, is the 136 gallons per ton gasoline?

Dr. FIELDNER. That is all computed as gasoline.

Senator MURDOCK. Now two other questions—I had a third. In England, what phase or step in the Bergius process is being used; you say we use the second step, or they use the second step at Baton Rouge and Elizabeth?

Dr. FIELDNER. Yes, sir; the second step of vapor-phase hydrogenation was used by the Standard Oil Co. of New Jersey for hydrogenating heavy petroleum.

Senator MURDOCK. At the Billingham plant, do they use both steps?

Dr. FIELDNER. Yes; from coal to the finished product which is gasoline.

Senator MURDOCK. As a result of the very wise move—at least in my opinion—on the wise move of the Department in asking Dr. Sayers to send engineers to make a study of the Billingham plant, the Bureau of Mines, when this legislation is passed, has the advantage, with the data and information that has been developed at the Billingham plant?

Dr. FIELDNER. Yes, sir; they have placed that information at our disposal, and their director of research is in this country at present. We have had several conferences with him.

Senator MURDOCK. I assume the knowledge we gained from the Billingham plant should save this country millions of dollars in this department?

Dr. FIELDNER. Yes, sir.

Mr. PAPE. May I ask, The figures you have given are for the extraction after using both steps?

Dr. FIELDNER. Yes, sir, both steps are included.

Senator ROBERTSON. Mr. Chairman, I would like to ask the doctor: The statement or information brought out at the beginning, by Senator Gurney, that is applicable not only to the net gallons per ton of the Sheridan but also on the same basis to the West Virginia, Alabama, Utah, and all other coals, where your figures show so many gallons per ton, it is actually so many gallons per 2 tons?

Dr. FIELDNER. Yes, sir; the figures that we have quoted are the gallons of gasoline obtained for each ton of coal that entered the processing and was liquefied. In general, another ton of coal is required to furnish the hydrogen and steam heat and the power consumed in the operation. You can call that part of the coal consumed as an operating cost, if you like. But we do give, in my statement, which was presented at the Washington, D. C., hearings, two columns, one of which contains the gasoline yield per ton of coal liquefied, and the other, the net yield of gasoline per ton of total coal used for all purposes.

Senator O'MAHONEY. Isn't this the proper distinction, that to figure the number of gallons per ton is the method by which you can test the exact amount of gasoline which can be derived from every ton of coal that is processed.

Dr. FIELDNER. That is true.

Senator O'MAHONEY. And the other figure is merely a figure of the amount of gasoline that can be produced from the amount of coal which is used, not only for the production of the gasoline itself, but also for furnishing the power to run the machinery, so to speak?

Dr. FIELDNER. That is correct, Senator.

Senator O'MAHONEY. So that if it were possible to obtain power and hydrogen from some other source than coal, the exact measure

of gasoline would be that given in your figures, namely for this Wyoming coal, 100 gallons per ton?

Dr. FIELDNER. That is correct. The reason we reported the results in this manner is because, as Mr. Pape has stated, the assay-yield is a definite figure but the other coal used is an operating factor which varies with the changes of conditions. The figure for total coal used is not as accurate as the figure for the yield per ton of coal treated. On the average the net yield of gasoline per total coal used is one-half of the yield per ton of coal liquefied.

Senator O'MAHONEY. The great virtue of these scientists is, that they always tell everything they know, and it becomes necessary for industrialists and the people generally, who are trying to learn something from what they say to analyze the statements made by the scientists. In other words, they have to submit the material submitted by the scientists to the three or four processes of extraction. Isn't that correct?

Dr. FIELDNER. That is correct.

Mr. PAPE. If I understand the trend of this then, the information will be given in the dispatches as 100 gallons per ton?

Senator O'MAHONEY. Of course, it is not within the powers of the committee to control the contents of the dispatches. We do our best. That is sometimes beyond our powers.

Senator ROBERTSON. In the layman's language, your figures show the saturation per ton of coal?

Dr. FIELDNER. That is right; that is the maximum yield, as we know it now.

Senator O'MAHONEY. May I interrupt you to state again to the gentlemen here representing the other States in an official capacity, we will be very glad to have you interrupt any time, and I am sure Dr. Fieldner will answer your questions, so do not hang back because there are a few Congressmen and Senators, but ask your questions.

Dr. ALEX C. BURR, of the Research Foundation of North Dakota. You stated a few moments ago, that while the cost of coal was approximately 25 to 30 percent of the total cost, might it not be true, that the figure still represents a major variable in the cost of producing oil, because of the fact some of the later steps, such as final conversion of gasoline, is independent of the coal from which your first oil is made, and therefore the cost would be the same for a variety of coals. It does not change the percentage that the cost represents, but emphasizes the importance of that?

Dr. FIELDNER. The second state of hydrogenation is approximately the same for all coals, but the capacity of the first stage and the hydrogen consumed varies with different coals. This variation will influence the cost as well as differences in the cost of the coal.

Dr. BURR. It still leaves the cost of coal the major variation which might be controlled through selection of coals? Other factors can be controlled.

Dr. FIELDNER. That may be correct, but other factors also influence costs. For example, the ease of liquefaction the rate of liquefaction, and the hydrogen consumed. High-volatile bituminous coals gave the highest yields but lower mining costs and greater ease of liquefaction may more than compensate for the lower yields of sub-bituminous coal and lignite.

Dr. BURR. That is variable more or less, or under the control of the operators. Small operations are not under such control.

Dr. FIELDNER. Yes; and secondly, these subbituminous and lignite coals in general liquefy more easily than the high-volatile bituminous coal.

Dr. BURR. That is independent of the eventual end?

Dr. FIELDNER. That is correct. The high-volatile coals, most of them, still have an important problem to be solved, and that is the liquefaction of a certain asphaltic residue that is obtained in the process. In England, they have not succeeded in handling that to their entire satisfaction, and they recommend that we should do more intensive research on this problem at our Pittsburgh station, in our small converters. That is the cheapest way to do the research, and we ought to multiply the number of units by five or six to solve these problems more rapidly. We think that certain residual liquefaction difficulties will be found with many of our high-volatile coals. That particular problem was not encountered in our work on bituminous coals and lignite. They liquefy easily in the process.

Dr. BURR. Might I ask: Does this ease in liquefaction affect the rate in liquefaction?

Dr. FIELDNER. It does. The higher rate of liquefaction is a favorable factor in the use of these coals. For example, Dr. Storch our chemist in charge, was asked what coal he would choose if he were obliged to build a plant today. He said, of all the coals he tested, he would choose Monarch coal because of its purity, ease of liquefaction, and low cost per ton. That does not mean that it is the best from all points of consideration.

It liquefied easily and gave no trouble in the process. We have as an offset advantage to the greater gasoline yields of the high-volatile bituminous coals, easier liquefaction of the subbituminous and lignitic coals, and a lower cost. Then there is a third factor from the point of view of national conservation. The high-volatile bituminous coals which are coking coals should be reserved for making coke. They comprise a small percentage of the national reserves. Our subbituminous lignitic coals are not suitable for transportation over long distances or storage for long periods of time. Therefore, in the national interest, they could well be utilized for making gasoline because in the liquid form they can be stored indefinitely and transported long distances.

Senator MURDOCK. In the production of coke from your high-volatile bituminous coals, in the process, you would also produce, would you not, a tarry or heavy oil susceptible of processing by the Bergius process?

Dr. FIELDNER. That is correct, and you could get a large yield of 25 to 35 gallons of tar per ton of coal processed, and that tar is an excellent raw material for a Bergius hydrogenation plant for making synthetic gasoline.

Senator MURDOCK. Reverting for the moment to the production cost in figuring the tonnage of coal necessary on the production side, the greater heat units contained in the coal the less you would need; is that not true?

Dr. FIELDNER. Yes, sir.

Senator MURDOCK. So that your bituminous coal has a decided advantage there, does it not on the production side, as compared to lignite and subbituminous coal?

Dr. FIELDNER. It does.

Senator MURDOCK. I don't want anyone to overlook any factors that may be present in Utah coals too.

Dr. FIELDNER. There are many different factors involved that must be considered. Some eastern bituminous coals have certain factors in their favor such as extremely low ash, low sulfur, and high yields of gasoline. A low-ash coal is especially advantageous for the Bergius process. And the contiguity to the great centers of population of the East would justify such plant in that region.

Low-temperature carbonization may be combined with the Bergius direct hydrogenation process, and/or the Fischer-Tropsch indirect process. The most advantageous combination will vary in different regions depending principally on the kind of coal available. That is why we favor the idea of a demonstration plant for each kind of process, direct hydrogenation, indirect hydrogenation, low-temperature carbonization and oil-shale distillation. It also may be desirable to have one plant for each rank of coal as high-volatile, bituminous, subbituminous, and lignite.

Senator GURNEY. Senator Murdock is very jealous of protecting the values of Utah coal, as Senator O'Mahoney is jealous of the Wyoming coals. I don't want Dakota to be out in the cold, so to speak.

Dr. THOMSON. Include Montana in that.

Senator GURNEY. May I ask you, Doctor, Isn't it in Germany they process the brown coal of Germany; that is about all they have?

Dr. FIELDNER. They have excellent bituminous coal in Germany in the Ruhr district, a fair grade of bituminous coal in upper Silesia. However, most of the German gasoline is made from brown coals.

Senator GURNEY. In other words, they are saving their high-quality coals for other purposes and are liquefying their brown coals; is that your information?

Dr. FIELDNER. I think that is one of the factors that enters into their consideration. Their bituminous coals were at the edge of Germany, in the Ruhr district on the west and in upper Silesia near the eastern boundary. The German coal supply was very seriously interrupted in the last war, and they were obliged to depend on the brown coal fields, in the middle of Germany. They were obliged to depend on this brown coal for most fuel purposes and save the high-volatile bituminous coal for metallurgical purposes. Therefore, it was quite logical to use brown coal for liquid fuel. Coupled with that, these brown coals yield on distillation a comparatively large amount of tar, much more than our lignites.

Senator GURNEY. It would be quite logical, in our national economy, especially maybe this new industry, to locate it in sections of our United States that are far in the interior, because we have too many now, of our defense plants on the edge of our country. It would be logical to bring them into the center of the country, where we have plenty of room, so to speak, and are free from attack in any war in the future. If we depend on gasoline from coal, we would like to bring that out. Also the brown coals Germany uses, are evidently most dependable to the Bergius process that they use in Germany. That is evidently right, or they wouldn't be using it. Do the brown coals compare with the lignite coals of the Dakotas, or more nearly like the Monarch coal here in Sheridan?

Dr. FIELDNER. They are different from either. The brown coal is perhaps the earliest stage in coal formation. Coal is formed from peat, and whenever peat is buried, the first product probably is brown coal. Then, after the brown coal has been buried under a heavy load of rock so as to develop heavy geological pressure on it, it is consolidated and becomes solidified, a bed of coal such as our lignites.

Greater pressure and over longer geological periods transforms lignite to subbituminous coal. Both lignite and subbituminous coal are hard and firm when mined but they weather on exposure, due to loss of water. There also is a difference in the vegetable material that formed the brown coal deposits of Germany and the source material of our lignites. The brown coals yield more tar and waxes on distillation than do our lignites. Most of the brown coals are mined in open pits, with the aid of scraper conveyors and drag lines. It is not necessary to blast the coal. It can be dug like gravel, and loaded on cars with electrically or steam driven shovels. You can see trucks and stumps of trees buried in the brown coal deposits. It is like a buried peat bog. In this sample of coal from the Monarch mine, there is evident a very brilliant, glossy band of coal. This band is the remains of a trunk of a tree that has been coalified. On careful examination, a person can see the actual grain of the wood in it. Under a microscope, the cellular structure of wood would be very plain. Brown coal is the first stage in the coalification of vegetable matter. Lignite is a little further advanced, subbituminous coal is more advanced and eventually the transformation reaches the stage of bituminous coal, which is our coal of maximum heating value and most suitable for the production of gas and coke.

Senator O'MAHONEY. It is evident from what the members of the committee ask of you, and what our guests ask, that there is a lot of coal in the western country, and in the country as a whole, and that suggests to my mind to ask you to state for the record how many products, to your knowledge can be made from coal?

Dr. FIELDNER. That is a very large assignment, Senator. There are thousands of products that are made from coal and its products. Included among these are disinfectants, medicines, dyes, photographic developers, fertilizers, organic chemicals, refrigerants, synthetic rubber, explosives, plastics, and various fuels. The principal byproducts from the carbonization of coal to make coke or gas, such as benzol, toluol, xylol, tar acids, creosote oil and pitch serves as raw materials for an endless variety of products, that are being devised for practical use by the industrial chemists.

Senator O'MAHONEY. In other words, there are innumerable uses to which coal can be put?

Dr. FIELDNER. There certainly are. And the different ranks of coal have their special advantages in these uses. Some of them will give more of one product than another.

Senator O'MAHONEY. I think it was Dr. Sayers, at our opening here that said even vitamins could be made from coal. Is that correct?

Dr. FIELDNER. That is correct, and one of our other witnesses in Pittsburgh—a representative of the Koppers Co.—said that a certain vitamin could be made from coal.

Senator O'MAHONEY. That was a research worker for the Koppers Coal Co.?

Dr. FIELDNER. Yes, sir; the Koppers Coal Co.

Senator O'MAHONEY. Now then, with respect to the coal which is turned to gasoline, what proportion of the coal is recovered as gasoline? Can you state in just a sentence?

Dr. FIELDNER. About 60 percent by weight for a high-volatile bituminous coal.

Senator O'MAHONEY. And the other 40 percent, of what is that capable?

Dr. FIELDNER. The other 40 percent consists of the ash-forming inorganic matter and unliquefiable carbonaceous matter in the coal, which may vary from 5 to 15 percent; water which in bituminous coal ranges from 3 to 15 percent; oxygen, sulfur, and nitrogen aggregating from 5 to 13 percent; and finally from 10 to 25 percent inflammable gases.

Senator O'MAHONEY. There are other byproducts in the process of making gasoline out of coal?

Dr. FIELDNER. Yes, sir; usable byproducts are tar acids for making plastics, that can be removed from the crude oil before it is further treated for complete hydrogenation to gasoline. Also butane may be obtained from the gas and this material can be converted to butadiene for the manufacture of synthetic rubber.

Senator MURDOCK. If you do that, you wouldn't get 60 percent of gasoline?

Dr. FIELDNER. No; it would cut it down a little, perhaps 10 percent. However, these tar acids converted to plastics may be more valuable than the fuel.

Senator O'MAHONEY. Leading up to this question, isn't it a fact, the use of coal for gasoline is a highly valuable and economic use?

Dr. FIELDNER. Yes, sir; it is a valuable and economic use. We should process as much of our coal as we can before we burn it as a crude fuel. Insofar as markets are available, the by-products of a coal carbonization plant are more valuable than the principal products of gas and coke.

Senator O'MAHONEY. Is there anything else you would care to ask?

Senator ROBERTSON. Section 2, of the bill provides the Secretary of the Interior is authorized, in paragraph (b) "to acquire, by purchase, lease for a term of years or less, donation, or otherwise." And in line 12, "secret process, technical data, inventions, patent applications, patents, licenses" and so forth. Have you any information as to what patents or patent applications that would include, and to whom they belong at the present time?

Dr. FIELDNER. That information is available; yes, sir.

Senator ROBERTSON. Could you furnish it for the record?

Dr. FIELDNER. I do not mean that it is available for the public, but it is in the hands of the Government. The Alien Property Custodian has considerable information available to the Bureau of Mines. Since the war began, certain restrictions on the publication of patent information, have been put in force and I doubt if I can put this data in the record.

Senator O'MAHONEY. The purpose of that section, I will say Senator Robertson, is to enable the Department to acquire, for the purpose of the plan, different processes or patents, should it be necessary to make the best possible use of the demonstration plants. And it is also the policy of the Department that any patents or any discoveries that may be made by the scientific employees of the Bureau, in the course of their studies, shall become the property of the

Government. It was felt in drawing the bill, that provision of this kind was necessary, in order to make certain that the Government could acquire patents and processes for the public, for whom the work is being done.

Senator GURNEY. Because I come from a farm State, and Wyoming is also a farm State, I cannot help but think of alcohol, made from farm products. I am reminded, too, by Senator Robertson's question or statement, that the saturation of gasoline in coal, as stated is from 63 to 136 gallons per ton. I remember in 1935 or 1936, it was definitely stated there were $2\frac{1}{2}$ gallons of alcohol in a bushel of grain. Since that, in a matter of 8 years, they have found out that they can extract $3\frac{1}{2}$ gallons of alcohol from a bushel of grain.

In other words, the advancement in the know-how, that they have found in the last 7 or 8 years, has proven to them that they can take out more alcohol than there actually is starch in grain. They turn some of the other ingredients in grain to starch, making more starch than there was originally in the grain. They do that chemically, and obtain $3\frac{1}{2}$ gallons, instead of $2\frac{1}{2}$ gallons, which they thought was in a bushel of grain 8 years ago. That is what we are trying to do with coal; is it not?

Dr. FIELDNER. Yes, sir.

Senator GURNEY. Seeking processes that give us more knowledge than we have at present, that is the purpose of this bill. We may find that we can get more than a hundred gallons of gasoline out of a ton of coal by further experimental work; is that not right?

Dr. FIELDNER. Yes, sir. We have a right to expect material improvement in these yields. The figures we have given are conservative figures which are based on our own investigations.

Senator GURNEY. Further experimentation and actual work with the problem might give us more end products out of a ton of coal?

Dr. FIELDNER. Yes, sir.

Dr. BEN PARKER, of the Colorado School of Mines. Dr. Fieldner has made some statements regarding commercial production of liquid fuels from coal on the British Isles.

I should like to ask Dr. Fieldner, if it isn't true, there is, at the present time, production on a commercial scale, of liquid fuels from oil shale, on the British Isles?

Dr. FIELDNER. Yes, sir; in Scotland, they have made oil from oil shale for many years. It is one of their oldest industries.

Senator O'MAHONEY. I will say, Dr. Parker, a good deal of the time, at the Salt Lake hearing was devoted to the discussion of oil shale. Mr. Kraemer, of the Bureau of Mines, is here to talk about oil shale, and I am sure, later in the day, he will be very glad to make a statement in regard to that. The committee recognizes the fact, particularly in southwestern Wyoming, northwestern Colorado, and in eastern Utah, there are tremendous resources of oil shale, which would furnish a supply of oil, which, according to the best estimates made available to us, is not less than 92 or 94 billion barrels of crude oil. Doctor, do you have any more to add?

Dr. FIELDNER. No, sir.

Mr. PAPE. I was rather impressed with his statement that the Monarch coal here lends itself to this treatment more easily than other coals, and that consequently the cost of production would be reduced on that account. Now, there are many other factors. For instance, isn't water a very necessary thing in this refining?

Dr. FIELDNER. Yes, sir.

Mr. PAPE. The availability of it?

Dr. FIELDNER. Yes, sir.

Mr. PAPE. Now, then, back to the Utah situation. As I understood, you felt the higher grade of coal could be better used for use classifications already known, and that the subbituminous coals do not have that broad number of use classifications, and that therefore using it for this purpose would bring it into a level somewhat comparable to these other coals, without injustice to Utah, because I told the Senator I was born there. I realize when it comes to this cost of production, the Utah coal has 12,500 units, whereas Sheridan has about 9,500. That ratio would be 40 percent less than in Utah coal.

Dr. FIELDNER. Only 24 percent less in heating value, and 26 percent less in yield of gasoline.

Mr. PAPE. On the other hand, it is probably known to the Bureau of Mines, that the cost of production of the subbituminous coal in the Monarch district is probably less than the cost of production of Utah coal. What I am trying to bring out, Mr. Chairman, is that the subbituminous coals, and the lignite in the Fort Union formation, do not have the demands, and are very limited in their market availability, due to poor quality. So that there is something in the plan that these coals ought to be used for this purpose, not only because of low cost and large extraction, and as a matter of equalizing the distribution of productivity throughout this country.

Senator O'MAHONEY. Dean Harrington, would you care to ask Dr. Fieldner any questions?

Dean HARRINGTON. Mr. Chairman, I do not think of any question I choose to ask at this time.

Congressman BARRETT. I would like to ask what are our bituminous, subbituminous and lignite coal reserves in the United States.

Dr. FIELDNER. Our total coal reserves are estimated by the United States Geological Survey as 3.2 trillion tons of all ranks of coal. This reserve consists of lignite, 0.94; subbituminous coal, 0.82; bituminous coal, 1.41; and anthracite, 0.02 trillion tons. The principal lignite reserves are distributed as follows: 600,000,000,000 tons in North Dakota, 315,000,000,000 in Montana, and about 23,000,000,000 in Texas.

Senator GURNEY. You left out South Dakota.

Dr. FIELDNER. The three States named have the largest lignite reserves. South Dakota has a reserve of 1,000,000,000 tons.

Congressman BARRETT. How about Wyoming?

Dr. FIELDNER. Wyoming has no lignite as this term is now applied but it has a reserve of 590,000,000,000 tons of subbituminous coal. New Mexico has 2,000,000,000 tons of subbituminous coal and 19,000,000,000 tons of bituminous coal. Colorado, 213,000,000,000 tons of bituminous and 104,000,000,000 tons of subbituminous coal. These are substantial reserves. Subbituminous coal and lignite comprise more than half the tonnage of our total coal resources. Expressed in equivalent tons of bituminous coal of 13,000 B. t. u. heating value, our total reserve of high-volatile bituminous coal is estimated at 1,400,000,000,000 tons; our subbituminous reserve at 600,000,000,000 tons and our lignite 484,000,000,000 tons.

Congressman BARRETT. Why couldn't we have that put in the record?

Dr. FIELDNER. That is in the record of my statement as given in Washington.

Congressman BARRETT. Could you put in the proportion of sub-bituminous and lignite?

Dr. FIELDNER. In tonnage, lignite comprises a little less than one-third of the total reserve and subbituminous coal about one-fourth. The two together, subbituminous and lignite, comprise about 60 percent of the total tonnage of coal resources.

Senator GURNEY. One more question. For the information of those here today, can you tell us, from present-day knowledge, how much it would cost to build a gasoline-coal refinery to produce any given number of barrels per day; what is the Bureau of Mines estimate at the present?

Dr. FIELDNER. The cost of a plant, such as at Billingham, England, making 3,500 barrels of gasoline a day, would be in the neighborhood of \$40,000,000.

Senator GURNEY. Thank you.

Congressman BARRETT. I want to ask this question: Would it follow, then, because of the fact that the better use could be made of bituminous coal, that the studies should probably follow more closely the subbituminous and lignite coals, and in the matter of extracting oil from the coal?

Dr. FIELDNER. Our studies should cover all ranks of coal.

Senator O'MAHONEY. Governor Holt, do you have any questions?

Governor HOLT. I think we have learned a lot, and I am happy North Dakota was prominently mentioned with its lignite deposits.

Senator O'MAHONEY. I think they are so great they could not be ignored.

Dr. Tullis, do you care to ask any question now?

Dr. TULLIS. I don't think so, thank you.

Senator O'MAHONEY. Mr. Kraemer?

Mr. KRAEMER. No, thank you.

Senator O'MAHONEY. Mr. Lee?

Mr. LEE. Well, in the question of studying of ranks of coal, I would like to know, at the present rate of consumption of coal, as coal, how long the bituminous coal of the eastern field will last.

Dr. FIELDNER. The high-volatile bituminous coals of the United States, if consumed at the same rate as we consumed them in 1941, would last 2,400 years; but that includes the whole United States. However, the majority of that tonnage is in Illinois and other eastern fields. In the eastern field, a shortage of the better grades of coal might develop in a few hundred years.

Senator O'MAHONEY. Dr. Thomas, do you care to ask any questions?

Dr. THOMAS. So far, the question has centered mostly around gasoline and other valuable products which might be derived from the process. I have wondered if the process outlined might not result in products which could be used in the manufacture of synthetic rubber.

Dr. FIELDNER. Yes; it is possible to make and recover butane, propane, and pentane in the liquefaction process. Butane is one of the principal sources of butadiene, which is used in the manufacture of synthetic rubber. It is now obtained from petroleum and alcohol, and we could obtain it from coal by liquefaction methods.

Senator O'MAHONEY. Dr. Thomson, of Montana, do you care to ask any questions at this time?

Dr. THOMSON. Not as bearing on this particularly, but I am prompted to a question which is of general interest to all of us—perhaps by Senator Robertson's in regard to the Germans' situation. We have been speculating about Germany's supply of lubricants, wondering if that wasn't one of the bottlenecks. Have you any observation or information as to how satisfactory lubricants Germany has been making from the ersatz gasoline processes and so on have proven; have we anything specific on that?

Dr. FIELDNER. We have information that the Germans have made and are making reasonably satisfactory lubricants by the Fischer-Tropsch process from coal.

Dr. THOMSON. You say "reasonably satisfactory?"

Dr. FIELDNER. We do not have positive information but we believe that the quality of these synthetic lubricants is being improved.

Dr. THOMSON. Thank you; that is all I have.

Mr. PAPE. May I ask one more question. Dr. Fieldner and I were discussing this before he took the chair. I would like to try to clarify one point. Under high-pressure-hydrogenation coal process, could you now tell us what you think the plant investment would be per barrel of production?

Dr. FIELDNER. I can't give you a figure of our own because that is why we hope this bill will be passed and enable us to get reliable cost data. Mr. Farish, the late president of the Standard Oil Co. of New Jersey, represented to the House subcommittee last year, that for the Bergius process, the approximate investment would be \$12,800 per barrel of gasoline made per day, and if that plant were increased to a capacity of 30,000 barrels per day, instead of 3,500 barrels per day, the investment cost would be \$7,500 per barrel per day. For the Fischer-Tropsch process, he estimates an investment of \$7,600 per barrel per day.

Mr. PAPE. So, following through our conclusions of the Monarch coal, producing a hundred gallons per ton, we could roughly say this figure of \$12,800 could be cut in two, about \$6,400 per barrel?

Dr. FIELDNER. That is, you mean that this investment cost would be halved if you use your method of charging one-half the coal used to the operating costs.

Mr. PAPE. Charge the second ton of coal to production costs, and consider that there are 100 gallons of gasoline to the ton of coal treated; that would mean somewhat over 2 barrels?

Dr. FIELDNER. That is right.

Mr. PAPE. Therefore, this figure of \$12,800 might be reduced to \$6,400 as a matter of estimate?

Dr. FIELDNER. You would have to multiply that estimate by 2, which would give the same investment cost for the plant.

Mr. PAPE. I can't see that, because your second ton is a matter of operating cost, not plant cost.

Dr. FIELDNER. This estimate is based upon the barrels of gasoline made, and not upon the tons of coal used.

Mr. PAPE. Consider, you say 2 barrels per ton. Then the figure would be reduced by one-half, per ton of coal treated—in other words \$6,400; isn't that right, figuring on a tonnage basis?

Dr. FIELDNER. It would be correct if Mr. Farish's estimate were based on tons of coal used, but his estimate is based on barrels of gasoline made, consequently it makes no difference to what account the coal is charged.

Mr. PAPE. This figure is per barrel?

Dr. FIELDNER. That is right.

Mr. PAPE. If the Monarch coal produces 2 tons to the barrel, it follows the cost would be one-half, or \$6,400. It doesn't matter. I have got the idea of what you are figuring on, this \$12,800 is per barrel?

Dr. FIELDNER. That is right.

Senator O'MAHONEY. When these plans have been completed and put into operation, I think we should be in much better position to figure what the cost would be.

(Dr. Fieldner subsequently supplied the following table for the record:)

Rank of coal	State	County	Bed	Mine	Gallons gasoline per ton of coal treated
Lignite.....	North Dakota	Ward.....	Coteau.....	Velva.....	65
Do.....	do.....	Mercer.....	Ft. Union.....	Beulah.....	63
Subbituminous.....	Wyoming	Sheridan.....	Monarch.....	Monarch.....	100
Do.....	Montana	Rosebud.....	Rosebud.....	Colstrip.....	81
Do.....	Colorado	Weld.....	Weld.....	Puritan.....	91
High volatile C bituminous.....	Indiana	Vigo.....	No. 4.....	Saxton No. 1.....	112
Do.....	Washington	King.....	Strain Upper McKay.....	Black Diamond.....	120
Do.....	Illinois	Franklin.....	Illinois No. 6.....	Orient No. 2.....	122
High volatile B bituminous.....	Utah	Carbon.....	Lower Sunny-side.....	Columbia.....	136
Do.....	Alaska	Jefferson.....	Mary Lee.....	Eska.....	136
High volatile A bituminous.....	Alabama	Monongahela.....	Upper Freeport.....	Sayerton.....	106
Do.....	West Virginia	Monongahela.....	Upper Freeport.....	Ind. Coll. No. 21.....	126
Do.....	Pennsylvania	Allegheny.....	Pittsburgh.....	Bruceton.....	130
Do.....	Alabama	Walker.....	Black Creek.....	Empire.....	134

Average values received or charged for coal free on board at the mine in certain States

From chapter on Bituminous Coal and Lignite, Bureau of Mines Minerals Yearbook 1942, pp. 23, 24, 39

State	Rank of coal	Percent of coal strip mined	Average value per ton f. o. b. mine
Pennsylvania.....	Bituminous.....	6.5	\$2.28
West Virginia.....	do.....	.8	2.23
Alabama.....	do.....	1.5	2.71
Illinois.....	do.....	25.5	1.81
Utah.....	do.....		2.33
Washington.....	Bituminous and subbituminous.....	.7	3.52
Colorado.....	do.....	.2	2.83
Wyoming.....	do.....	2.7	2.09
Montana.....	do.....	43.7	1.48
North Dakota.....	Lignite.....	66.1	1.27
South Dakota.....	do.....	93.8	1.52
Average for all States.....		10.7	2.19

Senator O'MAHONEY. The chairman is very happy to know that there have been present throughout the hearing today, and interested listeners to what has been going on, the executive committee of Local 230 of the United Mine Workers of America, Mr. Michael Petrovich, Mr. John Hutchison, and Mr. Andrew J. Mentock.

This afternoon the committee will assemble at 2:15, and the chair will be happy at that time to ask Dr. Schroeder, who for the Bureau of Mines went to England and inspected the British processes, and Mr. Kraemer, to devote, let's say, 15 minutes to the report of their

experiences. Mr. Kraemer will speak of oil shale. After that, we hope to hear from the representatives of the States which have been good enough to send their spokesmen here, and perhaps also from those coal operators from North Dakota, and from Wyoming, who have attended.

I see Mr. Glen Knox, from Sweetwater County, in the room, and Mr. Glen A. Sorenson, of Frontier, Wyo., representing the Kemmerer Coal Co. I also note the presence of Mr. M. H. Robinson, of Cheyenne, the president of the Frontier Refining Co. Mr. Robinson is engaged, at the present, in getting ready to make high-octane gasoline, and I know that his presence here indicates the petroleum industry is interested in what can be done with coal in this respect.

Senator GURNEY. May I make a little statement here?

Senator O'MAHONEY. We are delighted to have you do so.

Senator GURNEY. I understood, from Dr. Fieldner, that a great number of the present petroleum refineries could be used, or we could expect that they would be used in the second part of the process in making gasoline from coal. So we have part of the national plant erected at the present time. But making some computations from the answers given by Dr. Fieldner, first he said that it would cost \$40,000,000 to make a 3,500 barrel per day plant, and that would mean we would need 1,300-odd plants of that size, scattered around the country, to supply our present consumptive needs, if our consumption remains at the present high figure of almost a billion and a half barrels per year. Those 1,300-odd plants would cost, according to that figure, \$53,320,000,000. The doctor a little later gave another answer of the cost of the plant at \$7,500 per barrel per day. Breaking that down, I find we come out with an answer of 28½ billion dollars for a plant, or for plants to supply our present needs. It would give us some idea as to the size of the project we are contemplating.

Senator O'MAHONEY. The committee will stand in recess until 2:15.

(Thereupon, at 12:15 p. m., the hearing stood in recess.)

AFTERNOON SESSION

Pursuant to recess, the hearing was reconvened at 2:15 p. m., August 11, 1943, with the same members of the committee present as previously, whereupon the following proceedings were had:

Senator O'MAHONEY. The committee will please come to order.

I take a great deal of pleasure in announcing that just as I came into the room this afternoon, I met a gentleman from the East who never before has been in Wyoming, and he, so far as I know, outside of the members of the committee and members of the Interior Department staff, is the only person who has attended all of the sessions of this hearing on this bill. He is Mr. Carl Ulmer, assistant director of research of the Koppers Co., which is a Pennsylvania company widely engaged in the production of coal. I wonder if Mr. Ulmer wouldn't arise and let the Sheridan audience greet him.

Mr. ULMER. I am glad to greet the audience, Senator. I might add too, as Pittsburgh representative, I am very sorry indeed that I cannot vote for the Senator from Wyoming. [Applause.]

Senator O'MAHONEY. Senator Murdock will be required to leave this afternoon. Senator, would you say a word as we start our hearing?

Senator MURDOCK. Mr. Chairman, I want just to say this—that I am satisfied that the bill which has been sponsored by the distinguished senior Senator from Wyoming will be passed, and I am satisfied that regardless of where plants are located that the bill will result beneficially for the whole country. I am required to leave here before the hearing will conclude this afternoon, and I just want to say that while I cannot admit that Wyoming coal, or South Dakota coal, or any other coal, is quite equivalent to Utah coal, that the hospitality that has been accorded me, and this committee here in Wyoming could not be excelled in any other country in the world, and I hate to leave you, and I thank you. [Applause.]

Senator O'MAHONEY. The first witness this afternoon will be Mr. A. J. Kraemer, who is the expert on oil shale. I think we ought to have a little statement in the record here about the shale resources of this western country.

**STATEMENT OF A. J. KRAEMER, SENIOR REFINERY ENGINEER,
BUREAU OF MINES, DEPARTMENT OF THE INTERIOR**

Mr. KRAEMER. Mr. Chairman, members of the committee, ladies and gentlemen of the audience, I appreciate very much this opportunity of appearing before your committee in Sheridan, and to say a few words in behalf of oil shale. I think the testimony that has been given at other hearings of this committee leaves no doubt that it is generally conceded that oil shale deserves serious consideration in a program of development of sources of synthetic fuels.

The Bureau of Mines has been interested in oil shale and began its work on oil shale in 1916, and we have had an active interest in the subject during all of that time. The Bureau built an experimental plant on a somewhat semicommercial scale, using two different types of retorts, different in design and construction and different in methods of operation. In the operation of those two retorts, about 6,000 tons of shale was mined and retorted and the product of the retorts was about 3,600 barrels, or 150,000 gallons, of oil. The oil was sent to various research organizations for refining, and we ourselves, in an experimental oil-shale refining laboratory on the campus of the University of Colorado at Boulder, operating in cooperation with the University of Colorado, made refining studies of the oil produced at the plant in western Colorado.

During the time that has elapsed since the Bureau's plant was dismantled in 1929, changes have been brought about in the techniques involved in oil-shale mining, in retorting, and in shale-oil refining. It seems evident that advantage should be taken of those improved techniques to develop more satisfactory methods than those that were the outcome of our operations concluding in 1929.

At the hearing in Salt Lake City, I presented to the committee a short statement which has been mimeographed, and of which a few copies are available here, and I presented also for the record another statement which gives more detail of the Bureau's operations and discourses on the general questions of utilization of oil shale for production of liquid fuels. That report also has been mimeographed, and copies are available from the Information Division of the Bureau of Mines, at Washington, upon request. I am sorry we have no copies of that here. We sent some to Salt Lake City, but they did not arrive in time for the hearing, or up to the time we left there. I do

not know of any particular aspect of the question that should be discussed at this time. I would be glad to answer any questions within the limitations of time that are imposed on us, and my limited knowledge of the subject. Other than that, I call attention to the mimeographed statement.

Senator O'MAHONEY. Thank you very much, Mr. Kraemer. We appreciate your statement.

Now, Dr. Schroeder, would you tell the assembly here something about what you found out in Great Britain?

**STATEMENT OF W. C. SCHROEDER, ASSISTANT DIRECTOR,
FUELS AND EXPLOSIVES SERVICE, BUREAU OF MINES, DE-
PARTMENT OF THE INTERIOR**

Dr. SCHROEDER. Mr. Chairman, and members of the committee, guests, ladies, and gentlemen, one of the essential differences, so far as knowledge on synthetic liquid fuels is concerned, between England and the United States is largely due to the relatively better access that the British people had to German industry all through the period when Bergius and Fischer were developing in the processes. There are people in London who have made regular trips, monthly trips to Germany, right up to the beginning of the war. In London particularly there are a number of engineers who were forced out of Germany, who were well acquainted with the developments in that country.

During our visit we made a detailed study of the Billingham coal hydrogenation plant. There are a number of things about the plant that are extremely interesting.

The Bureau's small plant at Pittsburgh could be lost in the control room alone. When I went into the plant at Billingham, inevitably, I carried a picture in the back of my mind; a picture of our plant at Pittsburgh, and I was rather overwhelmed by the size of this installation. It covers acres of ground with converter towers from 60 to 70 feet high that handle pressures up to four or five thousand pounds per square inch. This plant is producing gasoline to run quite a fleet of airplanes over Germany every night, and can produce the equivalent of the highest grade motor or aviation fuels.

It also has certain features of especial interest with respect to bombing attacks because it is built for such very high pressures, it probably would not be damaged by bombing, unless there was a direct hit on essential pieces of machinery. This fact is probably one of the reasons why the English have not devoted much attention to bombing the hydrogenation plants in Germany, because unless they were very lucky, they would not damage them to any great extent.

From discussion with the British engineers and scientists it was very apparent they have a much fuller realization of the part synthetic fuels will play in the future than we have here in the United States. I suppose this is only natural. Our petroleum supplies have been ample and our efforts have been to produce gasoline perfectly suited for automobiles and more recently for tanks and airplanes. The English people, on the other hand, are devoting their efforts to making themselves self-sufficient, for when this war ends they want to have their own domestic source of supply for oil and gasoline.

After we left Billingham, we spent some days in the plant of the Scottish Oil Shales, Ltd. It is just outside of Edinburgh. They have been mining shale there since 1847 and are producing a fairly large

quantity of oil and gasoline. We had the opportunity to go through the entire plant, starting in the mine. Their operations form an interesting comparison with those of the Monarch mine, here in Sheridan. The seam of oil shale is fairly thick, I would say roughly 10 or 12 feet. Much of the drilling is done by hand. Cars are loaded by hand and hauled out by a pony. From the mouth of the mine the shale is put on a conveyor belt, carried to a crusher and from there to retorts where the oil is driven out. The oil is refined much like crude oil. Mining costs were better than half of the cost of producing gasoline from shale in this plant. The production per man day is about 6 tons of shale for the men in the mines. I suppose over-all production would run 3 or 4 tons per day.

In contrast to this operation, which is entirely by hand, when we visited the Monarch mine we found almost no hand work at all. The coal was blated down by the most modern methods. We watched them load more than 10 tons in 38 seconds, and unload 10 tons in 55 seconds. Here, the over-all production is 15 tons produced per man day, as compared to the Scottish oil shale mining of approximately 3 to 4 tons per man day.

Such differences would help materially to lower the cost of production for synthetic gasoline. In this same connection, I might mention that the average production per man day in English coal mines is $1\frac{1}{2}$ short tons as compared to an average of about $5\frac{1}{2}$ tons in bituminous mines in this country. This is not due entirely to the difference in methods and skill, for in England their coal mines have very thin seams, many not over 3 feet. Their men must work in difficult positions and without the help of modern mining machinery.

While we were in England, we had the most cordial reception. Imperial Chemical Industries gave us the assistance of five or six engineers during the entire time we were in the plant. They supplied information which was as complete and detailed as possible. I think also we can feel assured that they will help us with every detail of plant construction in our work here in the United States.

In closing, I would like to say, I hope these hearings will help the people of the United States to understand the need for synthetic liquid fuel as the people of Great Britain are beginning to realize that need, and that this will result in quick action of the bill that Senator O'Mahoney has proposed. Thank you.

Senator O'MAHONEY. Any questions.

Senator GURNEY. Some figures have been given. I would like to have you confirm them. To replace the Billingham plant in the United States, what is your idea as to the cost of doing that?

Dr. SCHROEDER. Well, the Billingham plant, as originally built in England, cost about twenty-five to thirty million dollars. That plant was built from 1932 to 1934 or 1935, and you would have to add at least 40 or 50 percent to the cost to reach 1943 prices. The present cost in this country might reach forty-five or fifty million. I think that is probably a fair estimate of what that plant would cost in the United States at the present time.

Senator ROBERTSON. The plant, as originally planned, has it been added to, right along?

Dr. SCHROEDER. I just mentioned the differential between the cost at the time of construction and at the present time. There have been changes and modifications, but I do not believe there have been any major additions.

Senator O'MAHONEY. Any other questions? If not, Doctor, we are very appreciative for your very complete report.

Senator O'MAHONEY. Governor Holt, will you come and speak for North Dakota.

STATEMENT OF THE HONORABLE HENRY HOLT, LIEUTENANT GOVERNOR, STATE OF NORTH DAKOTA, BISMARCK, N. DAK.

Governor HOLT. It is indeed an honor to appear before this committee as a representative of the Governor of North Dakota, the Honorable John Moses. Through press of engagements Governor Moses has found it impossible to attend in person, but has instructed me to personally express his appreciation of the national importance of the work in which this committee is engaged, and of his hearty support of Senate bill 1243.

Governor Moses also wishes me to offer the active cooperation of the State of North Dakota, through such official agencies as the college of engineering and the division of mines and mining experiments of the University of North Dakota, the North Dakota Geological Survey, and the North Dakota Research Foundation in furthering the objects expressed in the bill.

For my own part I would like to express full agreement with our energetic Secretary of the Interior when, in testifying before this honorable committee as far back as 1941, he said:

First, the future of the West depends upon a greater diversification and a wider use of its resources through the development of industries located close to the resources. No section of the Nation can prosper if it is treated as a colony; if its resources are pumped out of it and it is later left stranded. I believe that the West not only has many industrial opportunities, but has the right to insist that these opportunities be utilized.

Further, we agree with him when he also says:

I have always been a conservationist. Wise conservation does not mean hoarding of resources indefinitely. It means their intelligent, planned use for the permanent welfare of the whole community rather than for the temporary advantage of a few. We want no more short-lived boom towns and wasted fortunes. We want growing, permanent communities.

These words closely express the feelings of those thoughtful leaders of our State who are concerned about the social and economic future of North Dakota.

The citizens of North Dakota are hopefully looking to the future. They envisage the time when sound industries based upon the natural resources of their State will contribute to the economic development of their home communities. They are also planning for the most effective and rapid absorption into healthful social and economic life of that great portion of their citizens who will return from the active service of their country.

We in North Dakota are fully aware of the grave situation confronting our nation through the rapid exhaustion of our national heritage of petroleum. We are peculiarly aware of the gravity of this situation, because of the fact that, while having no local supplies of petroleum, we have a per capita consumption of major petroleum products one and one-half times that of the nation.

Therefore, Mr. Chairman, for these two reasons, one of them socio-economic, the other technical, we respectfully direct the attention of this committee to the known coal resources of North Dakota.

Let me remark, Mr. Chairman, that while North Dakota possesses more than 14 percent of the Nation's reserve tonnage of coal, and more than 7 percent of the reserve tonnage of the entire world, we still rank second to your great State in this matter. However, permit me to suggest that because of essential differences in the coals of our two States there is room for experimental development of both types of fuel.

I take pleasure in presenting to the committee members of our delegation who are availing themselves of the opportunity presented through your gracious invitations, of supporting Senate bill 1243 in a more technical manner, and who are ready to present more detailed information concerning the resources of North Dakota.

I would also add that one of this group, Mr. Prostel, is in position to clear up certain obscure points concerning the Lehigh Briquetting Co., which, according to press reports, were introduced into the record during the hearings in Washington.

Let me again assure you, Mr. Chairman, of our hearty support of this bill and our inescapable feeling that through your sponsorship, you and the members of your committee are rendering an inestimable service to our Nation in this critical situation.

And I want to add in conclusion, we are a thousand percent behind this committee.

Senator O'MAHONEY. Thank you very much, Governor Holt.

Mr. Fredrickson. Mr. Fredrickson is the executive director of the North Dakota Resources Board.

**STATEMENT OF FRED J. FREDRICKSON, EXECUTIVE DIRECTOR,
NORTH DAKOTA RESOURCES BOARD, BISMARCK, N. DAK.**

Mr. FREDRICKSON. Mr. Chairman and members of the Committee, my name is Fred J. Fredrickson and I am the executive director of the North Dakota Resources Board. The North Dakota Resources Board is a voluntary organization formed and supported by the business interests of the State of North Dakota for the purpose of coordinating the efforts being made to improve the economic situation in our State through the development of her natural resources.

It has been my pleasure and privilege to study carefully Senate bill No. 1243 both from the national and from the State viewpoint. In view of the fact that our present social and economic life is based to a remarkable degree upon the almost unlimited availability of cheap petroleum products, and the additional fact, amply substantiated by competent testimony already presented to this committee, that our reserves of petroleum are rapidly nearing exhaustion, I am fully convinced that this measure is most timely.

It is most gratifying that leaders in our legislative body manifest the insight and forethought reflected in this bill. The United States Bureau of Mines should not only be complimented upon the excellent work which they have done to study hydrogenation of coal, but should feel most fortunate in having the interest of such a committee as this.

In view of the enormous coal resources of North Dakota, it goes without saying that we have more than an altruistic interest in the success of this bill. I am sure that as the facts are developed, the members of this committee, and the experts of the Bureau of Mines will give due and weighty consideration to North Dakota as a prospective site for one of the proposed experimental plants.

Mr. Chairman, in behalf of the Resources Board of North Dakota, I want to heartily recommend and urge the passage of this bill, and in the name of thousands of citizens of this country thank you and the members of this committee for this public service.

Senator O'MAHONEY. Thank you very much, Mr. Frederickson.

STATEMENT OF EDWARD PROSTEL, SUPERINTENDENT, LEHIGH BRIQUETTING CO., DICKINSON, N. DAK.

Senator O'MAHONEY. Mr. Prostel.

Mr. PROSTEL. Mr. Chairman and members of the committee, my name is Edward Prostel. I was born in Germany, and graduated from the Technical University, Berlin, in 1923, specializing in fuel utilization. I entered the United States in 1926, and was naturalized in 1934. Since 1927, I am connected with the Lehigh Briquetting Co., at Dickinson, N. Dak.; since 1931 as superintendent in charge of operation. From 1937 to 1940, I was connected with the Dominion Briquettes and Chemicals, Ltd., Winnipeg, as consultant engineer in the reconstruction of the only other plant of this kind in North America.

In regard to the statement just made by Lieutenant Governor Holt, and in further regard to press reports about the hearing of this committee in Washington, it appears that some reference has been made to the Lehigh Briquetting Co. which may be misleading. About this company, I beg to submit the following statement:

The Lehigh Briquetting Co. is a Delaware corporation, organized in 1926. It received permission to transact business in North Dakota in 1927. The company built the plant near Dickinson in 1928. The plant consists of a mine, a power plant, a carbonizer plant, a distillation plant, and a briquetting plant. For the carbonizer the low temperature carbonization process of the American Lurgi Corporation was selected. The design originated from the German parent company of the American Lurgi Corporation which also supplied the engineering services for the construction of the plant and for putting it into operation.

Approximately 90 percent of the stock of the Lehigh Briquetting Co. is owned in North Dakota. There are no foreign interests. All officers and directors of the company are United States citizens and reside in North Dakota. The production of the plant at Dickinson in 1942 was 41,000 tons of char briquets and 310,000 gallons of tar acid or creosote oil.

It appears to me that in the national interest the bill being considered by this committee merits all our support for the conservation of our national resources, and for the future welfare of this Nation. And it is fortunate that the United States Bureau of Mines, with their experimental work at Pittsburgh, has already laid the groundwork for a successful execution of the program directed in this bill.

I have carefully read the statement presented by Mr. J. P. Williams, president, Koppers Co., Pittsburgh, Pa., to this committee at Pittsburgh, and I wish to endorse heartily his suggestion to diversify the program for the production of synthetic liquid fuel.

Instead of producing liquid fuel from coal, it is also suggested to carbonize the coal, use the char or coke where the coal is being used now, and to hydrogenate the tar. In the interest of safeguarding the national resources, this procedure would prevent the burning of the tar fraction with the coal as is practiced at the present time. Incidentally, such procedure will eliminate much soot, and will result in cleaner cities and will prevent damage to health and property. The hydrogenation of tar is less difficult and can be done in less expensive equipment than the hydrogenation of coal, and will supply

much valuable technical experience which can be utilized for the later hydrogenation of coal, if such should become necessary.

Any project of this kind should be located where the char can be absorbed in its raw state for industrial operations, power plants, metallurgical plants, hydrogen plants, etc., or in the shape of briquets as domestic fuel.

The low-temperature carbonizing process of the Lehigh Briquetting Co. appears to be practical for the carbonization of lignite or sub-bituminous coal which includes most coals found in the western States.

It is my sincere hope that this bill introduced by Senator O'Mahoney can speedily be enacted into law. Thank you.

Senator O'MAHONEY. Are there any questions? Dr. Fieldner, would you care to ask the witness anything about the briquetting plant in North Dakota?

Dr. FIELDNER. I would like to ask the witness whether the char that is obtained in the Dickinson plant is suitable for the production of hydrogen.

Mr. PROSTEL. Yes, it is.

Dr. FIELDNER. That is it would be a suitable raw material for the making of synthesis gas for the Fischer-Tropsch process?

Mr. PROSTEL. Yes, sir.

Dr. FIELDNER. Would you suggest also that the tar obtained in the carbonization of lignite would be suitable for liquefaction by the Bergius process?

Mr. PROSTEL. That is right.

Dr. FIELDNER. Then one might combine the two processes at one location. I am looking forward to the future, when we might build a carbonization plant for carbonizing lignite, a Bergius plant for hydrogenating the tar, and perhaps mixing some additional pulverized raw lignite with that tar, and thirdly, a Fischer-Tropsch plant for making synthetic gasoline from water gas which is obtained from lignite or lignite clear. Would you visualize such a plant as feasible?

Mr. PROSTEL. Entirely feasible. I do not think there are as many difficulties to overcome in such a scheme as with the liquefaction of bituminous coal.

Dr. SCHROEDER. Do you have to briquet the char before you can use it in the water gas machine to make hydrogen?

Mr. PROSTEL. There is a little question about that. Both methods have been tried, and both methods are feasible. Which is preferable, I couldn't say.

Dr. SCHROEDER. Have you tried it in Germany, or this country?

Mr. PROSTEL. In this country, in Minneapolis; the Minneapolis Gas Light Co. made the test.

Senator O'MAHONEY. Any other questions?

Thank you very much, Mr. Prostel.

**STATEMENT OF WESLEY E. KELLER, MINOT, N. DAK.,
VICE-PRESIDENT, TRUAX-TRAER COAL CO.**

Senator O'MAHONEY. Mr. Keller.

Mr. KELLER. Mr. Chairman and members of the committee. My name is Wesley E. Keller, and I reside at Minot, N. Dak. I am vice president of the Truax-Traer Coal Co., which owns and operates three

lignite strip mines and one slope mine in North Dakota. Our company also operates bituminous coal mines in Illinois and West Virginia; and is also part owner of a lignite mine in Saskatchewan.

Truax-Traer is the largest producer of lignite in the United States, mining approximately 30 percent of the total lignite production. Our company produces Velva lignite, which Dr. Fieldner referred to this morning, which will produce 65 gallons of gasoline per ton of lignite. Our company is highly in favor of Senate bill 1243, authorizing the construction and operation of demonstration plants. And we insist that the word "demonstration" be left in the bill, because we are entirely opposed to Government operation of commercial plants or enterprises. We appreciate the comments made by Senator Gurney this morning, quoting a portion of the bill, emphasizing the fact it was not the intention of the Government to operate these plants commercially in the event the procedure is successful.

In view of the broad national benefits to be derived, should the proposed demonstration plants to produce synthetic liquid fuels from coal prove successful, we feel that it is only just that the cost of research and experiments in that direction be borne by the general public. However, once proven, the plant or plants should be sold to private enterprises at a fair price for commercial operation.

Similarly, we favor other demonstration plants to determine whether it is commercially feasible or desirable to enhance to heat content and storage quality of lignite by steam-drying processes. Private corporations are not justified in risking stockholders' money for experiments of this kind even though they should be proven successful when the benefits are so greatly needed by the Nation in time of war and the general public in time of peace. Such research and experimentation is, we feel, a proper function of Government.

We received the invitation to appear at this hearing only last Saturday, and the time has been too short to give proper consideration to the various ramifications of the proposed bill. Therefore, we request the privilege, Mr. Chairman, of filing a supplemental statement, should further study make such action advisable.

Senator O'MAHONEY. That would be very satisfactory to the Committee, Mr. Keller.

Senator GURNEY. Mr. Keller, one question. From a location standpoint in the State of North Dakota, where are your lignite mines?

Mr. KELLER. One of our mines, the Burleigh mine, in Burleigh county, is 24 miles north of Bismark. Our Velva mine, in Ward county, is approximately 30 miles south of Minot. Our Kincaid mine, in Burke county, is about a hundred miles north of Minot, and about 20 miles south of the Canadian line.

Senator GURNEY. There is a lignite field that runs evidently from northern South Dakota, through North Dakota into Canada?

Mr. KELLER. That is right.

Senator GURNEY. I expect there are points in that area where the lignite coal is of the best quality?

Mr. KELLER. It varies some in various counties.

Senator GURNEY. Where would you say you will find the best quality of lignite coal?

Mr. KELLER. I am a little prejudiced in that regard, Senator, and some of our competitors may not agree with us.

Senator GURNEY. I would like to have your idea.

Mr. KELLER. It all depends on the use to which it will be put for domestic commercial or industrial purposes. Our Velva and Burleigh lignites are very popular, because of high fusion temperature, and lack of clinkering qualities of the ash for industrial purposes, particularly. I think Mercer County coals are very acceptable for domestic purposes as is the lignite from Burke County, where our Kincaid mine is located.

Senator GURNEY. Have you had any chance to compare the qualities of the lignite coals in South Dakota with North Dakota lignite?

Mr. KELLER. Not extensively; no. Generally speaking, I think probably due mostly to the fact that the production of the South Dakota lignite so far does not compare with the production of North Dakota lignite used. The North Dakota lignite seems to give greater satisfaction.

Senator GURNEY. Do you know anything about the quantities of lignite coals in the State of South Dakota?

Mr. KELLER. I don't know as to South Dakota.

Dr. THOMSON. May I ask a question. Mr. Keller, you mentioned you have some strip mines, and one slope mine. I don't want to embarrass you, but in terms of comparison, would you care to give us a rough figure of the cost per ton of strip coal to you versus the cost per ton of the coal which you take out of your slope workings?

Mr. KELLER. Frankly, I would be very glad to give you the comparative figure of our slope mine, but it is just in the process of development, and you will appreciate in the development stages of slope mining, the cost figures would not be dependable. However, as to strip mines, I have no hesitancy in telling our costs. On cars at the tipple, our costs are approximately 50 cents.

Dr. THOMSON. And would you state that the cost of your slope mining would be at least double that?

Mr. KELLER. No; I wouldn't think so. With modern underground machinery, it might be slightly more, but not double.

Dr. THOMSON. Thank you.

Senator O'MAHONEY. Any further questions?

Thank you very much, Mr. Keller.

Senator GURNEY. We will now call on Dean L. C. Harrington, dean of the school of engineering, University of North Dakota.

STATEMENT OF L. C. HARRINGTON, DEAN, COLLEGE OF ENGINEERING, AND DIRECTOR, DIVISION OF MINES AND MINING, UNIVERSITY OF NORTH DAKOTA, GRAND FORKS, N. D.

Senator GURNEY (presiding, Chairman Senator O'Mahoney having been called to answer a long-distance phone call). Mr. Harrington.

Dean HARRINGTON. Mr. Chairman and gentlemen of the committee: I have prepared a very brief statement for your committee. According to those who are in a position to know, the time is fast approaching when the Nation's petroleum reserves must be supplemented from other sources. This is the subject before your committee and under discussion today. The subject relates to the manufacture of synthetic fuels from coals of various ranks.

In one way or another this subject concerns the Nation pretty much as a whole. That gasoline and fuel oils can be produced from American coals through hydrogenation has been clearly demonstrated by the United States Bureau of Mines. Moreover, the Bureau has reported the possible yields from numerous types of coal.

Senate bill 1243 contemplates extending the Bureau's earlier studies through the construction and operation of demonstration plants in certain coal areas. Sponsors of this bill may expect the most hearty support and cooperation from North Dakota.

Experimental data indicate that high ranking eastern coals give higher oil yields than the lower ranking western subbituminous and lignite. This undoubtedly could be expected. It is a very serious question, however, whether the small reserves of high-rank coal should not be preserved for purposes for which neither lignite nor subbituminous coal can serve as substitutes.

It would seem reasonable, therefore, to consider the extensive deposits of both lignite and subbituminous coal as the logical source for synthetic fuels.

North Dakota's vast lignite resources today are still undeveloped. Only through the development of industries located within the State can extensive use of these resources be expected.

North Dakota, therefore, requests and urges that every reasonable consideration be given the erection of a demonstration plant within the State.

More details on this subject will be given by the speaker who follows.

Senator GURNEY. Thank you, Doctor, and thank you especially for the statement that we should preserve better coals for coking and steel purposes, and possibly domestic heating purposes also. It is a good plug for our western coals. We might also say that the evidence submitted to our committee in Pittsburgh and Salt Lake definitely proved also that we should get along with this gasoline-out-of-coal program in order to preserve in the ground, as national defense resources, the present limited supply of petroleum crude oil for that would be available quickly and cheaply, as it is now, in case of a national need like we have at present. In other words, it is one of our best defense items, crude oil in the ground. We should leave it there where it is stored securely and cheaply in case of a national emergency. We should get along by making fuel out of coal.

Senator GURNEY. Any other questions? If not, we will call on Dr. Alex C. Burr, director of research, North Dakota Research Foundation.

Mr. KELLER. May I amplify my answer to Dr. Thomson about mining costs. I just wanted to say the 50-cent figure I quoted is direct mine cost. I don't want it confused with the over-all cost. That 50-cent figure does not cover bonuses, insurance, royalties, transportation and things of that sort.

Senator GURNEY. Does it include plant cost?

Mr. KELLER. It does not include depreciation of the plant cost, cost loaded in boxcars from the tipple.

Mr. PAPE. May I ask you what is the over-all cost?

Mr. KELLER. Including everything?

Mr. PAPE. Yes.

Mr. KELLER. Do you want all costs, including administration, income taxes, and so forth?

Mr. PAPE. That is right.

Mr. KELLER. It probably will run \$1.20 to \$1.25.

Senator GURNEY. Now, Mr. Keller, you will be granted the same right to ask Mr. Pape that question for his company.

Mr. KELLER. I am sure we would be glad to have the answer.

Mr. PAPE. I would rather do it when I make my statement.

Senator GURNEY. Our chairman is back now. I would be very glad to have him take over.

Senator O'MAHONEY. Dr. Burr is the next name on our list.

STATEMENT OF ALEX C. BURR, DIRECTOR OF RESEARCH, NORTH DAKOTA RESEARCH FOUNDATION, JAMESTOWN COLLEGE, JAMESTOWN, N. DAK.

Dr. BURR. Mr. Chairman and members of the committee, I have a prepared statement. It was prepared and largely outlined before the hearing. I might deviate some in the way of additions.

My name is Alex C. Burr, and I am director of research for the North Dakota Research Foundation. By professional training and experience I am a chemical engineer. Upon the invitation of this committee, and at the request of the Honorable John Moses, Governor of North Dakota, I wish to present certain statements pertinent to Senate bill No. 1243, now under consideration.

It is not necessary to more than refer to the crisis arising from the rapid exhaustion of our national supplies of petroleum. That this crisis exists has been adequately established by competent testimony already presented. I believe that this committee is rendering a most important service to the Nation in providing for the timely expansion of the outstanding work thus far done by the scientists of the Bureau of Mines in studying the hydrogenation of coal. The forethought thus shown, in acting before the crisis becomes more acute, is most commendable, and I find myself in entire sympathy with the spirit and the provisions of Senate bill No. 1243.

The coal fields of North Dakota constitute one of the most potentially valuable resources of the entire United States. Within an area of 28,000 square miles, in the western part of the State, are to be found approximately 600,000,000,000 tons of lignite coal, near the surface, and in veins of 3 feet or more in thickness. This tonnage is given in round numbers to facilitate computation. This enormous deposit constitutes 14 percent of the total coal reserves of the Nation, and 7 percent of the total coal reserves of the world. It is second only to the deposits within the State of Wyoming.

While the North Dakota reserves are being depleted at the rate of approximately 2,000,000 tons a year, the national reserves are being depleted at the rate of approximately 500,000,000 tons a year; or 35 times as fast. Therefore, the strategic significance of the North Dakota deposits is rapidly increasing.

I would like to present a large-scale map of North Dakota, showing the location of the coal fields in the western part of the State, some 28,000 square miles. They extend into Canada, in this direction, South Dakota to the south, and Montana to the west. I might remark the map indicates the main railroad lines penetrating the oil fields.

I might say 600,000,000,000 tons, if placed in one cube would extend $4\frac{1}{2}$ miles in each of the three directions.

Senator GURNEY. Generally speaking, Mr. Burr, that lignite coal is in the western part of North Dakota, directly west of the line, west of the Missouri River, extending north toward Canada?

Dr. BURR. Most of it is.

These enormous North Dakota resources are as yet almost untouched, either in service to the State or to the Nation. They form an almost inexhaustible storehouse, not only of fuel, but also of raw materials for a wide range of synthetic chemicals, as a potential source of industrial gases such as carbon dioxide, carbon monoxide, and hydrogen, and as a source of synthetic liquid fuels. In this connection, it should be remembered that much of the present war economy in Germany is based on coal resources poorer in quality and only 75 percent as extensive as those of North Dakota, but intensively developed and utilized at a rate 100 times as great.

North Dakota coal fields can be readily developed to meet the ever-increasing needs of the Nation because of the quality of the coal, the nature of the deposits, the low cost of mining, and the ease of access to transportation. The present annual production, never more than 2½ million tons, is all used as fuel. The greater portion of this coal, some 63 percent, is mined by strip, or open pit methods. The frequency rate for accidents is among the lowest in the Nation, table I; the rate of production, measured in tons per man-day, is the highest in the Nation, table II. The rate of production per day is the highest in the Nation.

Senator GURNEY. May I interrupt, Mr. Chairman. Dr. Burr has four tables here that I would like to have placed in the record.

Senator O'MAHONEY. That will be quite agreeable, and they will be carried in the record at the conclusion of his statement.

Dr. BURR (continuing). Because of this, and close technical supervision, mining costs have been kept at a minimum consistent with good practice and safe operation. The cost of mining North Dakota coal, whether measured in dollars per ton, or in dollars per million British thermal units, is the lowest in the Nation, table III.

North Dakota coal fields are easily accessible for further development, being crossed and criss-crossed by four transcontinental railroads: the Great Northern, the Northern Pacific, the Soo Line, and the Milwaukee. This means that lignite, and all products derived from lignite, can be readily shipped to all parts of the State and Nation.

With these points well in mind, I would like to refer briefly to certain facts established by the Bureau of Mines, and to certain conclusions founded directly upon those facts. Technical Paper No. 622 shows that North Dakota lignites hydrogenate readily to petroleum-like oils. The tons of hydrogen consumed per ton of oil produced are well within the limits for the coals tested, being neither the highest nor the lowest. They fall right in the group. The oil produced from a North Dakota lignite is highest in the important tar acids, highest in the desirable low boiling constituents, and among the highest in aromatics.

In addition, it is found that, upon combining the data on the cost of mining coal with the yield data of Technical Paper No. 622, the cost of coal per ton of oil produced is lowest for North Dakota lignite. Supporting data is found in table IV.

Furthermore, there is under consideration, for erection in North Dakota, a pilot plant for the production of hydrogen from lignite.

The testimony of Prof. Lloyd H. Reyerson, of the University of Minnesota, recently appearing before the House Steel Shortage Investigating Committee, was that this process, developed at the university under his supervision, would provide hydrogen at a lower cost than would any other process.

For these reasons, the enormity of the North Dakota lignite deposits, the low cost of the coal, the qualities of the oil produced, and the availability of cheap hydrogen; we would recommend not only the passage of Senate bill 1243, but also that at least one of the experimental plants provided for in the bill be located in North Dakota.

We are firmly convinced that the purposes of this bill will be more adequately met if several small pilot, or semi-commercial plants, of say 100 tons of coal per day capacity, be built than if one plant, much larger in capacity, be built.

The final commercial development of the processes for the hydrogenation of coal will mean not only the saving of the present refining industry and the continuance of our present "Gas" society, but will also result in the establishment of a new and important chemical industry. To the extent that this development involves the use of our lignite, it will mean much to the economy of North Dakota to bring increased industry, employment and wealth to the western part of the State. At the same time, North Dakota will, through its enormous coal resources, make a major contribution to the technical economy of the Nation.

(Tables submitted by Dr. Burr.)

TABLE I.—*Frequency rate mine accidents*

1940:		
All mineral industries.....		61
Bituminous coal.....		70
Anthracite.....		107
1940: Frequency rate for North Dakota mines.....		55

TABLE II

A. Tons of coal per man per day for selected States and years

	1935	1936	1937	1938	1939	1940
North Dakota.....	7.61	8.20	7.41	8.62	8.57	8.83
Texas.....	7.22	7.57	7.56	7.64	6.30	6.55
South Dakota.....	2.46	3.58	6.05	5.65	5.82	6.25
Montana.....	2.96	3.60	4.00	3.55	3.52	3.58
Illinois.....	5.97	6.55	7.25	7.35	7.98	-----
Pennsylvania.....	4.16	4.22	4.16	4.40	4.77	-----
West Virginia.....	4.74	4.89	5.00	5.16	5.51	-----

B. 1940 production in selected North Dakota counties

County	Production	Tons, man day
Burke.....	260,480	14.91
Burleigh.....	255,885	13.66
Divide.....	154,070	15.60
Mercer.....	621,905	11.35
Ward.....	477,016	8.18
Total.....	1,769,356	¹ 11.1

¹ Weighted average.

NOTE.—These 5 counties produce 81 percent of the annual coal production.

C. 1942 production—selected mines

Company	Mine	Production	Tons, man day
Baukol-Noonan.....	Noonan.....	173,688	17.2
Knife River.....	Beulah.....	362,306	15.7
Dakota Collieries.....	Zap.....	275,561	5.8
Lehigh Briquet.....	Dickinson.....	113,285	4.7
Truax-Traer.....	Columbus.....	218,532	17.4
Do.....	Wilton.....	272,787	20.8
Do.....	Velva.....	367,453	13.9
Total.....		1,783,612	¹ 11.3

¹ Weighed average.

NOTE.—These 5 producers produced 72 percent of the annual production.

TABLE III.—*Cost of coal at tipple*

[In dollars per ton and cents per million B. t. u.]

State	District	B. t. u.	Ton, strip	C/Mil- lion, B. t. u.
			<i>Dollars</i>	<i>Cents</i>
North Dakota.....		6,500	0.40	3.08
Illinois.....	10	11,000	1.37	6.23
Montana.....	22	10,000	.71	3.55
Ohio.....	4	12,500	1.52	6.06
Pennsylvania.....	1	13,500	1.71	6.32
Do.....	2	13,500	1.77	6.55
West Virginia.....	3	14,000	1.64	7.04
Do.....	7	14,000	2.67	9.50
Washington.....	23	11,000		
Wyoming.....	19	10,350	1.22	5.94
Utah.....	20	12,500		

State	District	B. t. u.	Ton, all coal	Million B. t. u.
			<i>Dollars</i>	<i>Cents</i>
North Dakota.....		6,500	0.80	6.16
Illinois.....	10	11,000	1.58	7.00
Montana.....	22	10,000	1.34	6.70
Ohio.....	4	12,500	1.90	7.59
Pennsylvania.....	1	13,500	2.33	8.64
Do.....	2	13,500	2.28	8.44
West Virginia.....	3	14,000	1.84	6.56
Do.....	7	14,000	2.41	8.60
Washington.....	23	11,000	3.70	16.80
Wyoming.....	19	10,250	1.92	9.35
Utah.....	20	12,500	2.04	8.00

TABLE IV.—*Cost of coal per ton of oil produced*

No.	Coal	Percent oil yield	Cost of strip coal per ton oil	Cost of all coal per ton oil
1	Alabama.....	52	4.36	5.41
2	Pennsylvania.....	64	2.77	3.56
3	Illinois.....	60	2.28	2.63
4	Washington.....	59		6.26
5	Colorado.....	45		5.40
6	Montana.....	40	1.77	3.34
7	Wyoming.....	49	2.49	3.91
8	North Dakota.....	31	1.29	2.58

Senator O'MAHONEY. Dr. Schroeder, do you have any questions?

Dr. SCHROEDER. I had one, though it isn't exactly a question. In Washington, Dr. Heroy, Director of Reserves, Petroleum Administration for War, stated that if the known reserves of oil were spread out over the District of Columbia, which is roughly 8 to 10 miles on a side (73 square miles) it would cover the area to a depth of 50 feet. If we assume it requires about 10 tons of lignite per ton of oil then the 600,000,000,000 tons in North Dakota would furnish over 20 times as much oil as our known reserve of 20,000,000,000 barrels of petroleum. This would cover the District of Columbia to a depth of 1,000 feet. These figures indicate the comparative magnitude of this lignite reserve in this State alone.

Dr. BURR. Not only that side of the picture, Dr. Schroeder, but at the present rate which the deposits are being mined, they will last the State of North Dakota 250,000 years. Then we admit we are second to the deposits of Wyoming.

Senator O'MAHONEY. So there isn't much danger of our running short in our lifetime.

Dr. BURR. The State of South Dakota has 1,000,000,000 tons—to answer an earlier question, Senator Gurney.

Senator GURNEY. What was North Dakota?

Dr. BURR. Six hundred billion.

Senator GURNEY. You had some costs in mining, in one of the tables. Would you like to bring them out?

Dr. BURR. In view of the many questions that have been asked at several of these hearings, it might be well to bring that out. The cost of coal at the tipple is given in table No. 3, in the appendix. The data is taken from 2 sources. The Federal Bituminous Coal Commission has issued a report this past spring in which they include the cost of coal at the tipple for all coal mining districts in the United States, with the exception of North Dakota, and I have taken that information from their published reports. The cost for North Dakota I have gathered myself, and I have carefully checked with several producers, and I might read off the cost per ton for strip operations. The cost per ton, delivered at the tipple, for strip mines in North Dakota is 40 cents per ton; Illinois \$1.37 per ton; Montana, 71 cents per ton; in Ohio it is \$1.52 per ton; in Pennsylvania, district No. 1, it is \$1.71 per ton; in Pennsylvania, district No. 2, it is \$1.77 per ton; in West Virginia, district No. 3, it is \$1.64 per ton; West Virginia, district No. 7, it is \$2.67 per ton; no record of strip operations in either Washington or Utah. In Wyoming, it is \$1.22 per ton. Now this table gives the cents cost per million B.t.u., giving advantage of North Dakota lignite over all other fuels, with Wyoming coal as 10,250 B.t.u. I notice a misprint, as Mr. Pape this morning said 9,500. I gave him credit for the cost of the figures taken from the Bureau of Mines publication. The cents per million B.t.u. for North Dakota is 3.08, which is the lowest. It rises to a value of 9.5 for West Virginia. Now, for all coal in the State of North Dakota, strip and underground included, the cost in dollars per ton runs from an average of 80 cents in North Dakota to \$3.70 in the State of Washington. Giving the cents per million B.t.u., it runs from 6.16 in North Dakota to 16.80 in Washington. With exception of the figures on North Dakota, which I have carefully checked with the producing mines in the State, the other figures are matters of public record. Does that cover that point?

Senator GURNEY. I think so, very nicely.

Mr. PAPE. What is the purpose of the figures? After all, it is not the cost at the tippie. It is the final cost to the government for this coal. It must take in all overhead cost in making comparison; it should be fair.

Dr. BURR. Lignite should be included with subbituminous, which is one of the coals in question. I might add that the figures of the subbituminous coal in Wyoming and Montana, the cost at the tippie was taken by the Bituminous Coal Commission, for such purposes, in view it was the fairest way for comparing the costs. That is the reason they choose that particular method. It is one way of explaining the over-all cost. It has been entered in the record of the hearings at Pittsburgh that Illinois had the highest production in tons per man per day of major coal fields. But North Dakota has the highest figure reported by the Bureau of Mines for 1939, the last year for which I have complete figures, the average tons of coal per man per day was 8.57 tons, Texas 6.30, South Dakota 5.82, Montana 3.52, Illinois 7.98, Pennsylvania, 4.77 and West Virginia 5.51 tons. For 1940, North Dakota, 8.83, which is still the highest. That is caused largely by the modern methods of production in the coal fields having considerable tonnage produced by strip mines. If we take the 5 counties out of the 20 in which coal is produced in North Dakota which produce over 80 percent, the figures would be 11.1 tons per man per day. For 1942, the 5 major coal-producing companies produced an average of 11.3 tons per man-day, ranging from 4.7 tons per man-day to 20.8 tons per man-day. I included all concerns producing over 60,000 tons a year. That accounts for the low cost, if that is converted to the cost of coal per ton of oil, taking the yearly figures taken from paper 622 of the Bureau of Mines, which shows North Dakota lignite 31 percent of oil per ton. That includes Alabama, Pennsylvania, Illinois, Washington, Colorado, Montana, Wyoming, and North Dakota. North Dakota has the low cost of \$1.29 strip coal, per ton of oil, to the high cost of \$4.36 for Alabama. If, instead of applying it to strip coal, we take the production for the entire State, it runs from a low of \$2.58 in North Dakota to a high of \$6.26 in the State of Washington for all coal per ton of oil. Does that cover the point, Senator?

Senator GURNEY. Very well.

Mr. PAPE. May I ask a question. I don't do it with the idea of curiosity, but merely to get at the facts. What did you say the production per man was in North Dakota?

Dr. BURR. The average in 1940, covering 204 mines, was 8.83 tons, on the last figures.

Mr. PAPE. I think you said that was the highest?

Dr. BURR. That is the average.

Mr. PAPE. For these Western States?

Dr. BURR. That is the highest for the entire State.

Mr. PAPE. Is it higher than Montana and Wyoming?

Dr. BURR. Yes.

Mr. PAPE. I want to correct that. Montana had 10 tons last year, and the State of Wyoming has over 8 now. And northern Wyoming has 15. Now in the comparisons you make, I think you ought to be more careful, for fear they will be misleading.

Dr. BURR. These figures are taken from the mineral report of the Bureau of Mines, and cover the entire State. If you pick sections of the State, such as western Wyoming, or northern Wyoming, we will

pick one from North Dakota which averaged 20.8 per man. I took the average for the State.

Mr. PAPE. For instance you give Montana 3.52, while it is 10. All you took in Montana was the underground mines. You overlooked the strip mines.

Dr. BURR. In 1940, the rate for Montana, including strip mines, as reported in the Mineral Reserves Report of the Bureau is 3.58. That includes strip mines. I have not gone beyond the source, but I have found, on checking with the figures from the report on North Dakota, that they check with those I have determined in North Dakota. The question should be taken up with the Bureau of Mines, because I have taken their figures from the Minerals Yearbook.

Mr. PAPE. I don't care to go further with it. I wanted to correct it. I think the record will give the production per man per day. It is in the Bituminous Coal Division file and should be given consideration, if this is a subject to be considered in the final disposition of this question.

Dr. SCHROEDER. Doctor Burr, approximately how many cubic feet would a ton of lignite occupy as mined?

Dr. BURR. The mined lignite would occupy about 45 cubic feet to the ton, and in the seam it runs around 25.

Dr. SCHROEDER. Twenty-five in the seam?

Dr. BURR. Twenty-five to thirty.

Dr. SCHROEDER. On which are those estimates of 9 cubic miles based?

Dr. BURR. That was based on 25.

Senator GURNEY. You might put in the record here now that Congress didn't renew the life of the Guffey Coal Act. Mr. Pape might like to know that.

Dr. THOMAS. In the testimony presented by Dr. Fieldner, he points out that the total estimated reserves of lignite in America are 484 billion tons. I wonder if there is a discrepancy?

Senator O'MAHONEY. It should be pointed out when these figures are assembled, they are assembled by different witnesses from different sources or from different times. We get testimony from innumerable sources, and we have to check one set of figures against another, when it becomes important, to be accurate with the results. Why a million or two tons of coal one way or another, I think makes very little difference. We do know that we are talking in figures beyond the imagination, so far as coal is concerned. The resources of the United States, and particularly of these Western States, are practically unlimited.

Governor HOLT. Mr. Chairman, to answer this question, Dr. Fieldner made the statement that the available supply of lignite was 600 million tons in North Dakota, 300 billion tons in Montana, and some in South Dakota. He did not exactly have the figures, but the total of the known available tons of lignite were better than 1,500,000,000,000 tons of lignite.

Dr. BURR. Comparatively recently there has been a change in the method of reporting coal, because of the great variation of heat value. I have checked with Dr. Fieldner, and we are taking our figures from the same source. His figure of 484 billion tons is "equivalent tons of 13,000 B. t. u. per pound." There is no discrepancy there because, Mr. Senator, we are as jealous of the accuracy of our data as you and your committee. Thank you for the privilege of answering that.

Senator O'MAHONEY. Dr. BURT, we are very much indebted to you. Dr. TULLIS. We would like now to hear from South Dakota.

**STATEMENT OF EDWARD L. TULLIS, DEPARTMENT OF GEOLOGY,
SOUTH DAKOTA SCHOOL OF MINES, RAPID CITY, S. DAK.**

Dr. TULLIS. Mr. Chairman, members of the committee, ladies and gentlemen: Many of the things that we had intended to say have been said, and there is no need to say them again. My name is Edward L. Tullis. I am head of the department of geology, School of Mines. Dr. Gries and I are here as representatives of Governor Sharpe of South Dakota, and also of Dr. Joseph P. Connolly, President of the South Dakota School of Mines.

Senator GURNEY. At this time, Doctor, I would like to put in the record, the committee's thanks to Governor Sharpe for sending you on such quick notice, and to you personally for coming on so quickly. The notice was sent to the Governor some few weeks ago that this meeting was to be held, but evidently did not come to his attention. Therefore, you were not given much time, and we are very glad to have you here.

Dr. TULLIS. Before talking about South Dakota lignite or any lignite, I would like to correct an error in answer to a question regarding oil sands in the Black Hills. There are a few small outcrops of sand containing oil at the surface, but they apparently are not of commercial importance, so far as our present knowledge goes.

Our knowledge of lignite in South Dakota is largely contained in the records of the South Dakota Geological Survey, and the U. S. Geological Survey and South Dakota School of Mines Technology.

I think that I can say, so far as lignite in South Dakota goes, it is to be classed with lignite in North Dakota. They are part of the same geological structure, and development of the field should proceed as one field. The rank, or we might say, known quality of the South Dakota coal is about the same as that of North Dakota. Both are variable, as might well be expected. In one rather small area, in the north central part of the State, near Isabel, there is a small quantity of coal, a few million tons, averaging a little higher rank than the rest of the coal in this geologic structure, but the quantity when speaking of billions of tons hardly seems of importance.

Senator GURNEY. What does the Isabel coal test in B. t. u.'s, if you know?

Dr. TULLIS. Quoting from the reports of the South Dakota Geological Survey, the B. t. u.'s are roughly 10,600. It is just a graph here. It isn't completed. This is on a moisture-free basis.

Senator GURNEY. Thank you.

Dr. TULLIS. Certain advantages of the lignite have been stressed, and there is no need to refer to these advantages. To a geologist or mining engineer I would say the thing to consider in getting coal out of the ground is the most economical way of doing it, and there are many factors, most of which I think have been mentioned here, probably all. And most of them can be reduced to some economic basis. Some of them are also to be considered from the point of conservation, which certainly has its economic aspects. I would like to stress one of these as it appears to a geologist and engineer; that is, the stripping of coal. Some costs have been presented, no exact comparison, but there does not seem to be much question that the cost of strip mining is

less than underground mining. One other thing is extraction. In strip mining more complete extraction can be had than in underground mining. It is possible with proper strip mining to get practically all of the coal. With underground mining, from 30 to 50 percent of the coal is left and probably can never be recovered.

I cannot give you any exact estimate of the amount of coal that can be strip-mined in South Dakota or North Dakota. I don't think anyone has figures, but judging from figures that are available from present developments, it would look like there are a few hundred million tons that are available by direct strip operations. I think in the case of initial operations, anything that can keep costs down in operation is to be considered. Finally, I would say the matter of where operations should be undertaken, which seems to be the question that has been in the back of a lot of people's minds, should be decided from an analysis of the economic factors and engineering point of view, giving, if possible, relative weights to the different economic factors. That is a difficult thing. These things include mining costs, perhaps distance from the market—that may or may not enter into our processes, relative cost of extraction from different types of coals.

Senator O'MAHONEY. Thank you very much, Doctor. Are there any questions?

Dean HARRINGTON. This relatively high lignite coal in South Dakota—is that being extensively mined?

Dr. TULLIS. It is the only one that is. It is the geologically oldest coal that is being operated in North Dakota, South Dakota, or eastern Montana lignite area.

Mr. O. T. SOLBERG (of Bismark). Would you reduce that B. t. u. down to the raw coal?

Dr. TULLIS. On the same basis, I can give you the other coals; would that help any?

Mr. SOLBERG. No. What is the B. t. u. on the wet basis?

Dr. TULLIS. I am not sure I have that. I can give you the Fort Union coal, which is most of the North Dakota coal, on the same basis.

Mr. SOLBERG. We have the Fort Union.

Dr. TULLIS. On the same basis, that is all I can give you. I don't have the figures here. The Isabel coal, as I say, is 10,600.

Mr. SOLBERG. Is that on a wet or dry basis?

Dr. TULLIS. Moisture-free.

Senator O'MAHONEY. The chairman feels this is an opportunity, quite proper, to interject this remark: The divergencies of testimony which we have here with respect to the costs of production and the degree of recovery, indicate one reason why the members of this committee feel it would be altogether unwise for the Government to undertake to produce liquid fuels on a competitive basis. This elicits the résumé of the policy we are following, namely, of sponsoring the construction of demonstration plants. After these demonstration plants have been built, then ample opportunity will be afforded not only to the experts of the various States, but to the private interests of the various States to develop on a commercial scale. I think the evidence will work out the answers to the various questions propounded here. I can say, as chairman of the committee here, I would not want to assume the responsibility of determining which coal could be most economically produced. The Bureau of Mines' tests, as envisaged by the Department's committee, are merely designed to undertake the initial investment of investigation, which private

industry to date has been unable to undertake, and it is unlikely it will on a scale sufficiently broad to lay the basis for the sort of development which we ought to have. The Government will do the pioneer work. It will tell private industry where the work can be done most efficiently and economically.

Mr. PAPE. I would like to ask for the United Mine Workers, that is, whether or not the coals mined in North Dakota are union-mined coal?

Governor HOLT. Yes, sir; they are.

Mr. PAPE. Are they in North Dakota?

Governor HOLT. Yes, sir.

Mr. PAPE. Isn't it a fact the United Mine Workers do not have their organization there?

Governor HOLT. I think perhaps you are right there. That organization has never been operating there—the American Federation of Labor—they belong to that organization.

Mr. PAPE. I want to bring that out there. The Government will have to give consideration to that when these demonstration plants are built. It would be inconceivable that the Government would recognize wages on such an extremely low level a man cannot exist, where other States are paying the top wages. I think that ought to be in the record.

Governor HOLT. I would like to state for the record, we have no thought of entering into any controversy, Mr. Chairman, and we believe that the wages paid by the coal companies of North Dakota are comparable to any other State of the Union. We have representatives of the companies here, but we are not paying starvation wages. I can assure you that we have not entered this testimony with a view of starting a controversy, and we will let the case rest.

Mr. PAPE. I think it is quite pertinent. A great deal has been said about the cost of production. Certainly wages paid is a material factor. If you folks in these two States are paying wages much lower, not necessarily starvation wages, but wages much lower than we are paying in the subbituminous field, that should be given consideration, in trying to arrive at true costs.

Governor HOLT. If that is true, we have no objection.

Mr. ULMER. The witness—referring to this question of comparative quality—seems to have before him a printed or mimeographed publication. I wonder if we could have reference to that entered in the record, if the publication itself will not be there?

Senator O'MAHONEY. I am sure the witness will provide it for the record.

Dr. TULLIS. This is a publication entitled "South Dakota Coal," published by the South Dakota State Planning Board in 1936, but the data were taken from reports of investigation by the South Dakota Geological Survey.

Senator O'MAHONEY. Does Mr. Gries wish to testify?

STATEMENT OF J. P. GRIES, SOUTH DAKOTA SCHOOL OF MINES, RAPID CITY, S. DAK.

Mr. GRIES. I am J. P. Gries, also with the School of Mines. I don't have much to add to what has been said. There is one point, partially discussed this morning, that I might bring up in this connection. When Dr. Fieldner was talking, he gave us this table, to the effect 65 gallons of gasoline or oil could be recovered from a ton

of lignite, going on to 136 for the very highest grades of coal. In some of the previous meetings of the committee, at which I was not present, some other figures were entered on that same subject, figuring on a different basis. I think the record should show that the lignite may have around 35 percent moisture. That moisture is easily driven off, and the cost of driving off the moisture is relatively small. High-grade coal may have a 5-percent moisture—from there on up. Then, if we do not consider that moisture but calculate on a dry basis, the amount of oil recovered from a ton of dry lignite increases from 65 gallons to 100, whereas the amount of oil recovered from high-grade coal with a 5-percent moisture will increase from 136 to 142 or 143 gallons. So on a percentage basis, that looks a little better. The figure we had this morning, lignite would produce only half as much oil as high grade coal, but if we figure on dry lignite, it figures two-thirds to three-fourths. That was not brought out here, even if it is in the record of the other meetings. Driving off the water incidentally does not have any effect on the other point brought out this morning; that is, the fact you can liquefy the lignite more easily than the high-grade coals. I believe that is the only point I care to comment on.

Senator GURNEY. I think that simple statement in the record makes your trip to Sheridan very much worth while, and gives the Dakotas a much better chance to be considered at the present time, and I certainly want to thank you for coming.

Dr. TULLIS. May I comment on his statement, that is to this effect, that the cost of driving off the moisture, and thereby offering it more nearly the quality of the other types of coal, is a relatively small portion of the total cost of the process. That makes it better, perhaps.

Senator GURNEY. For the record, Roy E. Leigh is geologist for the Chicago, Milwaukee Railroad, and I am sorry that such a good railroad does not come into the confines of Wyoming. We in the Dakotas have learned to like the Milwaukee Railroad. They are always on tap to furnish us all kinds of information from an industrial or agricultural angle. They keep in their organization some very fine technical men, and they have been very helpful to our State, innumerable times in the years past, and having Mr. Leigh here today is just another evidence they are wanting to help the people along their line.

STATEMENT OF ROY E. LEIGH, GEOLOGIST, CHICAGO, MILWAUKEE & ST. PAUL RAILROAD, CHICAGO, ILL.

Mr. LEIGH. Mr. Chairman, I wish to thank Senator Gurney very much for that very helpful plug.

Senator O'MAHONEY. He is always doing that, especially where South Dakota is concerned.

Mr. LEIGH. I did not come here prepared to testify at this hearing. My primary object was to learn as much as I could, to report that to my superiors. I was not authorized to testify, and what evidence I might have, probably would be of little value in comparison to that which has already been given. I will say, however, that the Milwaukee Railroad has been very much interested in the development of lignite and subbituminous coal fields, and minerals for a good many years. And as far back as the early part of this last winter, the

Milwaukee road has taken an interest in the production of gasoline from coal, and have taken that into consideration at several of our meetings.

Senator O'MAHONEY. Thank you very much.

STATEMENT OF FRANCIS A. THOMSON, PRESIDENT, MONTANA SCHOOL OF MINES, AND DIRECTOR, STATE BUREAU OF MINES AND GEOLOGY, HELENA, MONT.

Senator O'MAHONEY. Dr. Thomson, is it time for Montana to add in a word here?

Dr. THOMSON. I don't know what chance it will have, Mr. Chairman, in the presence of the able representative of South Dakota. As part of my official testimony, let me say first of all, that I am in no sense an expert on coal, and particularly on the hydrogenation of coal. I have taken great pleasure in sitting at the feet of my professional colleagues, all of whom are personal friends of mine, and learning here today, and I am personally indebted to you, and Montana is officially indebted to you, Mr. Chairman, for giving Montana the opportunity to learn what is being done, and what the possibilities are in this field of hydrogenation of coal.

I, just in passing, want to make one thought with reference to Senate bill 1243. First, that it struck me, when I read the bill, that although I am rather innocent in legislative matters, I am always a little skeptical about legislation which does not include an appropriation. I presume that is otherwise anticipated, and will be taken care of in another way.

Let me say, too, in connection with this matter of demonstration plants. First, I am entirely in sympathy with you, Mr. Chairman, in your expression of the view, that the Government should pioneer in the field, but that from the pioneer stage on, it should be a matter of private enterprise. However, I would urge this, and I say this, not from any knowledge of coal mining, really from my ignorance of coal mining, but my fairly good knowledge of metal mining, we find even pioneer plants, experimental plants, demonstration plants, must go to a considerable scale before any conclusions can be drawn in regard to the cost of operation. So I would hope that these demonstration plants will be ultimately of a sufficient scale, so that private industry can gain an idea of what the costs are likely to be. If the experiments are confined to too small a scale, we find, in metallurgical work, that it is impossible to draw any conclusions in regard to costs on a large scale.

Now, as to the situation with respect to Montana—Montana is very definitely interested in this bill and in this program. Montana particularly and generally is in favor of it, and if, as one of the representatives for Montana here, there is any assistance which I can give to our committee by commending this bill to our Senators and Representatives, we shall be very happy to do that.

Montana, in the matter of volume of lignite coal available, has not put itself forward in the sense that North and South Dakota have done, and for the very obvious reason, Senator Gurney, that Montana has such a wealth of mineral resources, that coal has not attracted our people to the same extent. According to information from the geological survey, Montana has between three hundred and

four hundred billion tons of known mineable coal, the great bulk of it in eastern Montana, as a part of this Fort Union field, which is present also in North Dakota, South Dakota, and to some extent, in Wyoming. Incidentally, the total mineral production of Montana is about three and a third billion dollars. If we value this coal at 1 cent a ton, it will exceed the value the total mineral production of Montana today. So we are interested in the utilization of Montana's coal resources, particularly in the utilization of the black lignites, which are elsewhere classified as semibituminous. We are interested too in the utilization of our coal which can be recovered by strip mining. I do not know that anyone has any specific figures on this, but the proportion is very large, and I would call attention to the fact Colstrip, Mont., has one of the largest advantages of strip operations anywhere in the West, and without desiring to prolong this controversy as to cost, and so forth, I am reliably assured that the output per man at Colstrip is all the way from 30 to 40 tons per day,¹ and we must put that into the figures with respect to cost of labor. With respect to the utilization of this lignite, I would be disposed to make this point, that in Wyoming, for instance, Wyoming has such a wealth of other coal, and there are markets and needs for these other coals. Dr. Fieldner referred this morning to the necessity for conservation of cokable coal for metallurgical purposes. This lignite, in these three or four Western States is in a large measure unutilized at the present time. The other coals are being utilized at a more rapid rate. Therefore, it seems to me it would be in the interest of national economy, to emphasize particularly the utilization of these lignitic coals for the manufacture of liquid fuel, rather than use up the other coals for which there is a present and immediate future demand. As I say, we don't know how much of the coal is strippable. We know, immediately north of here, up the Tongue River, there are large resources of strippable coal, mapped for years, which are not now being utilized.

As to the location of the plant, I am disposed to be generous, and think perhaps the best location for it might be North Dakota. They have paid more attention to lignites. We have done practically nothing, so it would be entirely agreeable to us to see the demonstration plant, if there is one for the lignites located in North Dakota. Whatever comes out of that, with the wealth of coal Montana has, Montana will ultimately profit from the erection of a demonstration plant.

I think the other coals should be included in the program, along with oil shale, of which Montana has almost none. Ultimately, as a matter of national economy, emphasis should be placed on the utilization of the lignite coals, and much of the strippable coal lies in an area which is tributary to the very fine city of Sheridan which has entertained us so splendidly.

Senator O'MAHONEY. Thank you very much, Doctor.

Are there any other representatives from North Dakota, South Dakota, or Montana who desire to be heard? If not, I will call on the State geologist of Wyoming, Dr. Thomas.

¹ Exact figures range from 60 to 70 tons per man day.

STATEMENT OF H. D. THOMAS, STATE GEOLOGIST,
CHEYENNE, WYO.

Dr. THOMAS. Senator O'Mahoney, Members of the Committee, Ladies and Gentlemen: I have no prepared statement to bring before you. During the course of the discussions, there have been hundreds, perhaps, of points come to my mind, which I might use to urge the passage of Senate bill 1243. However, I am certain that these will not all come back to mind.

I simply want to say that I am deeply appreciative of the opportunity to appear here as a representative of the Honorable Lester C. Hunt, Governor of Wyoming, and as a representative of Dr. J. L. Morrill, president of the University of Wyoming.

I am certain that all of the State agencies of Wyoming, including the State geological survey and the University of Wyoming, would be most happy to cooperate with any demonstration plant which might be set up as a result of the passage of this bill.

The University of Wyoming is the scientific center of the State of Wyoming and these are located there many agencies which could be helpful in later stages of the program as it is hoped it will develop. I might mention also, that there is at the university at the present time, a branch of the United States Bureau of Mines, a petroleum experimental station. That station is staffed with fine petroleum chemists and refinery engineers. It seems to me that after the creation of these demonstration plants, many problems of processing will arise with the new materials derived from the first crude extraction or synthesis. I am certain that the staff of the experimental station at the university would be most happy, and certainly finely qualified to cooperate in any manner in the general program.

I would like to say, to get away from coal, that Wyoming is, of course, an important oil-producing region. There are going to be new oil fields found in the State, and through various methods there will be greater recovery in old ones. I believe Wyoming will long continue to be an important oil-producing region. It would seem feasible to lend all aid possible to stimulate the exploration for new petroleum reserves. I would like to emphasize that that would be solely an emergency measure. Looking far into the future, it seems to me that the farsighted attitude we should take would be to urge the passage of this bill.

So far as coal is concerned, it has been brought out in the testimony that Wyoming is the richest coal-bearing State, in that we have about the equivalent of the North Dakota tonnage, but of sub-bituminous and bituminous rank. I am certain any of that coal could be used in a demonstration plant, and that in all likelihood, any of it would prove to be subject to processing.

There is but one other matter which has been called to my attention by one of the residents of Campbell County. During the course of the testimony given, much attention has been paid to strip mining, and this gentleman, being a public-spirited citizen, has pointed out that near Gillette, strip mining is carried on extensively, on a 60- to 90-foot coal seam in that locality. I believe that if additional information were desirable on that point, that Mr. A. A. Schlaht, of Gillette could furnish additional information.

Senator O'MAHONEY. I will interrupt you, Dr. Thomas to say that Mr. Schlaht has handed to the committee, a statement on the deposits in Campbell County, in which I find this statement: "Estimates show that 35 to 50 men in a strip mine can produce as much coal as 350 men in a shaft mine." I have no doubt that this statement covers some of the facts with respect to that operation in Campbell County. The committee, in any event, is aware of the deposit, and of the work that has been going on, which is carried on by the Wyodak Co., a subsidiary of the Homestake Co., which operates in the State of my colleague, Senator Gurney of South Dakota. At the conclusion of your statement, I will ask that this statement, presented by Mr. Schlaht, shall be printed in the record.

Dr. THOMAS. I believe I have nothing more to say.

Senator O'MAHONEY. Are there any questions to be addressed to Dr. Thomas? If not, we are very much indebted to you, sir.

STATEMENT PRESENTED BY THE COMMITTEE ON INDUSTRIAL AND POST-WAR
PLANNING OF THE GILLETTE, WYOMING, LIONS CLUB

General.—The committee on industrial and post-war planning, representing the community of Gillette, Wyo., endorses bill S. 1243, authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes. The committee further believes in the purposes underlying this bill, namely, that the day is fast approaching when petroleum must be supplemented as an industrial and domestic fuel and as a source of gasoline. Much research is undoubtedly necessary before processes for coal hydrogenation can be put on a full commercial basis. Federal construction and operation of demonstration-type coal hydrogenation pilot plants is desirable at this time because liquid fuel will continue to play an important part not only in time of war, but in peacetime as well.

Campbell County coal resources.—It is only natural that representatives from Campbell County, Wyo., should show an interest in this type of legislation. The entire area of this county, comprising about 4,200 square miles, forms a large portion of the famous Monarch bed of subbituminous coal. Tests made at the Bureau of Mines Experimental Plant have established a gasoline content of better than 40 gallons per ton of coal found in this area. (The specific test shows a gasoline content of 42.9 gallons per ton from samples used from the Monarch coal mine in Sheridan, Wyo.)

Accessibility.—The coal deposits in Campbell County are more readily accessible than any other deposit in this section of the country. The huge veins of coal varying from 60 to 100 feet in depth, are covered with dirt (no rock) ranging from only a few feet to 30 feet in thickness. Thus coal operations in the Gillette, Wyo., area could largely be of the strip type. Strip mining is recognized as the cheapest and fastest means of mining. More than that, less manpower is utilized under practically nonhazardous conditions in this type of mining than in shaft mining. Estimates show that 35 to 50 men in a strip mine can produce as much coal as 350 men in a shaft mine. Furthermore, there are no mechanical limitations to strip mining, such as are found in the tippie capacities in shaft mines.

The Wyodak Coal & Manufacturing Co. is operating an open pit mine now, and the Echeta Coal Co. plans to be in production by September 15, 1943. Analysis shows that the type of coal to be mined at the Echeta field is similar to that in areas further west. This is substantiated by the fact that the Bituminous Coal Commission has given the same minimum rate for the coal to be mined at Echeta as that now mined at Sheridan. This rate is slightly higher than the Wyodak rate.

Advantages.—Rail transportation on the Chicago, Burlington & Quincy Railroad is available at both of these mines. Gillette is a city of 2,271 friendly people, has good schools and churches, two modern and well-equipped hospitals, and ample housing accommodations.

Operating wells in and near Gillette show an abundance of water. One well is capable of producing more than 2,000 gallons per minute.

The surrounding country is predominantly agricultural, and live stock raising is the major industry. An abundance of foodstuffs would be available at the source of production at all times.

Gillette and Campbell County is populated with public spirited and wide-awake citizens eager to cooperate in any worthy projects.

Conclusion.—We agree with the statement of Petroleum Administrator Harold L. Ickes, "To begin with we need data for designing commercial plants and on construction costs. Lacking these, we can hardly expect that private capital will readily venture to finance a brand-new, untried industry, no matter how large and important it is likely to grow in the future." The O'Mahoney bill, S. 1243, is designed to attack this problem from the proper angle.

We further agree to cooperate with the Bureau of Mines, other agencies or officials to the end that a pilot plant may be established at Gillette, Wyo., should investigations finally reveal that such would be a feasible undertaking.

Furthermore, we are aware that exhaustive studies will be made prior to the establishment of future coal hydrogenation plants. We have not repeated a technical report, since we realize that the Federal Bureau of Mines is the clearing house and gathering agency of such information. We merely want to emphasize that we have the coal resources; that these are easily made available for use in an efficient manner; and that the community in general welcomes and is wholeheartedly behind the general program of developing hydrogenation processes on a commercial basis.

The Gillette, Wyoming, Lions Club Committee on Industrial and Post-War Planning welcomes the opportunity of being of further service.

A. A. SCHLAHT, *Chairman*.
ALEX B. MAYCOCK,
W. B. SAUNDERS,
ELWOOD ANDERSON,
W. H. UNDERWOOD,
H. F. DICKEY,
FRANK SANDERS,
FLOYD LUCAS,

Members.

Dr. THOMPSON. May I supplement my testimony, Mr. Chairman, that I made a little investigation of the Tongue River area. There is one feature of that which I think is deserving of attention, namely, that most of the coal there is Government coal. It is in homesteads which were patented with the coal reserved. The rest or most of the rest of it is in Government owned land, leased under the Taylor Grazing Act. In the vicinity of Birney, on the Tongue River, there are vast areas of strip coal, which are still Government owned. It might have some bearing on the situation. May I ask Governor Holt what the title situation is in North Dakota?

Governor HOLT. Privately owned.

Mr. SOLBERG. We operate Government-owned coal at Knife River, N. Dak.

Dr. BURR. There is a chart in part 1 of the hearing that lists Government-owned coal. I think reference to that will show a fraction over 3 percent in North Dakota.

STATEMENT OF D. H. PAPE, PRESIDENT, SHERIDAN-WYOMING COAL CO., INC., DIRECTOR, NATIONAL COAL ASSOCIATION, REPRESENTING WYOMING AND MONTANA: AND DIRECTOR, BITUMINOUS COAL RESEARCH, INC., MONARCH, WYO.

Mr. PAPE. Mr. Chairman, ladies, and gentlemen, I have no prepared statement. There is little that I might add except to clear the record in some respects. I represent here today the Sheridan-Wyoming Coal Co., Inc. I am president of that company. As director of the National Coal Association and Bituminous Coal Research, Inc., I represent those institutions, and particularly those operators belonging to those institutions, who carry on their mining operations in the northeastern part of Wyoming and in the State of Montana.

While I served with the National Coal Association in Washington, D. C., there was a great deal of effort expended by the association and its membership in an endeavor to create a department having for its purpose a continuing effort in research looking to the enlargement of the bituminous industry as well as subbituminous and lignite, through a more refined utilization of their chemical constituents. Little was accomplished at the time, but recently those engaged in the industry have become interested in the possibilities resulting from research. In the year May 1, 1942, to July 31, 1943, the industry expended in various forms of research upwards of \$99,000. Bituminous Coal Research, Inc., is now putting on a campaign to raise \$2,500,000 for coal research, the same to be expended over the coming 5 years. Enthusiasm in the industry indicates that this program will be financed and consummated.

The action of Senator O'Mahoney in introducing Senate bill 1243 authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances to conserve and increase the oil resources of the Nation as well as for other purposes; and the support given by Secretary Ickes, the officials of the Bureau of Mines as well as the War Minerals subcommittee of the Committee on Public Lands and Surveys, United States Senate, deserves and I hope will receive the unqualified support of all coal producers in the United States. Such research work as is contemplated can only redound to the future benefit of the coal industry.

I would like to discuss briefly the subject of coal reserves. R. I. No. 3680, published by the Bureau of Mines, Department of the Interior, January 1943, page 5, indicates that the reserves of subbituminous and lignite coals in 1935 in the States of Montana, North Dakota, and Wyoming were 1,568.4 billion tons, and that these reserves exceeded the reserves of bituminous coal in the entire United States by 160.6 billion tons. Of the total reserves of subbituminous coal in the United States, namely, 818.2 billion tons, 590.0 billion tons were located in Wyoming as of the date these statistics were compiled.

In a reprint from Industrial and Engineering Chemistry, volume 32, page 1372, October 1940, quoting a report from the Central Experimental Station, United States Bureau of Mines, Pittsburgh, Pa., it states among other things—

Another subbituminous coal sample was obtained from the Monarch No. 45 mine (Sheridan-Wyoming Coal Co., Inc.) at Kleenburn, Sheridan County, Wyo. The Monarch is one of the important beds of the Sheridan coal field, which is situated east of the Big Horn Mountains in northeastern Wyoming. The Sheridan field is, in turn, part of the great Fort Union coal region lying in North Dakota, Montana, and Wyoming. According to the United States Geological Survey (1), the subbituminous coal in the Fort Union region reaches its best development in the vicinity of Sheridan.

From the same paper the following statement appears:

The Monarch coal hydrogenated easily and is as good as the McKay bed coal from Washington, as far as ease of operation is concerned. The heavy oil from the Monarch coal was thin enough so that it could be centrifuged without dilution with overhead oil, and the centrifuged oil was a satisfactory vehicle for suspension of about 40 percent of coal.

It is true that the coal of the Fort Union beds reaches its best development in the vicinity of Sheridan. It is well known to those who have closely examined the beds in the vicinity of Sheridan that the very best of the coal from a hydrogenation point of view is contained in the lands owned by the Sheridan-Wyoming Coal Co., Inc.,

and in the lands of the Government leased by the Sheridan-Wyoming Coal Co., Inc., and in lands owned by the Government which can be most economically developed through the lands owned by the Sheridan-Wyoming Coal Co., Inc.

In R. I. No. 3680, page 36, table 13, it is indicated what the production of gasoline in gallons is to the ton of coal for various coals.

Gallons of gasoline per ton of coal

Alabama, high volatile A	105
Do	134
West Virginia, high volatile A	126
Pennsylvania, high volatile A	130
Utah, high volatile B	136
Indiana, high volatile C	112
Illinois, high volatile C	122
Washington, high volatile	120
Colorado, subbituminous B	91
Wyoming, subbituminous B	100
Montana, subbituminous C	81
North Dakota lignite	63
Do	65

The records of the Bituminous Coal Division of the Department of Interior will indicate very clearly that the underground cost of producing a ton of coal is less in the Monarch mine than in any other underground mine of a relative size in the United States. When the true cost of production is taken into consideration along with the gasoline content per ton, as indicated above, it is my opinion that the cost of a gallon of gasoline extracted from the Monarch coal will be much less than the cost of a gallon of gasoline extracted from any other coal in the country. This statement as to cost of production per ton is one that can be easily verified, as I have said before, through the records of the Bituminous Coal Division.

As and when the Government finds itself in a position to proceed with the construction of development or demonstration plants it is my opinion that the Sheridan-Wyoming Coal Co., Inc., will be in a position to sell coal to the Government at a cost per ton delivered in demonstration plant lower than other coal districts of the country. Further attention is called to the fact that the coal which would be furnished by the Sheridan-Wyoming Coal Co., Inc., would come from Government land on which the Government would receive a royalty for each ton produced.

Land for the plant is available here in Sheridan field at a low cost. There is ample water supply. Transportation facilities are here. The Chicago, Burlington & Quincy Railroad Co. serves all markets at comparable freight rates.

In closing, I would recommend demonstration plants for both the lignite and subbituminous fields.

I think that is all I have to say. I think the record contains everything.

Senator O'MAHONEY. Are there any questions?

Mr. KELLER. Mr. Chairman, may I ask a question?

Senator O'MAHONEY. Mr. Keller.

Mr. KELLER. Senator Gurney suggested in view of the fact Mr. Pape asked me what our over-all cost was, that he might be willing to give us his.

Mr. PAPE. Well, of course our costs are a matter of public record with the Bituminous Coal Division. Notwithstanding, I will give

you the total cost. We put our coal on the railroad car for 80 cents a ton. The difference between that and \$1.25 represents our over-all cost. For instance in that is bond interest—I said we would sell the coal to the Government for \$1.25, our cost reported by the Bituminous Coal Division was \$1.40. Of that, 15 cents was bond interest. The bonds will be retired on our property within a year, which will reduce our cost to \$1.25, and those costs contain the depreciation. When I said we would be willing to sell to the Government for \$1.25 per ton, we would do that as a matter of contribution to help develop this proposition, with which our people, in a discussion with them on the telephone last night, said they are thoroughly in accord with and want to see go forward.

I want to say further, in conjunction with a demonstration plant in northeastern Wyoming, we own 15,000 acres, on both sides of the Burlington, from the city of Sheridan, 3 miles beyond the mines you visited yesterday. I want to say this: We are not mining the coal in this acreage, because of the fact we thought we might help ourselves and help the Government in this war, by leasing Government coal. We have just recently leased—and by the way, Senator O'Mahoney knows about that—some 1,200 acres from the Government, and that acreage contains upwards of 50,000,000 tons. We have also leased from the State of Wyoming some 500 acres, and the coal will be mined from those two leases before we mine any coal from our own property. If a demonstration plant were built on our property, all of the coal would be mined from Government land, and the Government would get a royalty per ton on whatever coal was mined. That should be an added advantage to the Government. In the demonstration, they would be making a profit while their theory was being worked out.

Dean HARRINGTON. May I ask what his tonnage is.

Mr. PAPE. Our tonnage this year exceeded 1,250,000 tons through this one mine. The Government—I have been consulting with the solid fuel administration—asked for a million and a half tons to be produced. They are converting from oil to coal in the northwest—that is still in the embryonic stage, and we are approaching that million and a half tons, which will be taken from the same mine. As a matter of fact, we could take 5,000,000 tons from the same mine, if the Government needs the coal bad enough. In our mine in the Basin, we are producing 150,000 tons this year, probably 250,000 tons. The country is badly faulted.

Congressman BARRETT. The 15,000 acres the Monarch mine has, is that all fee land?

Mr. PAPE. No, about 14,000 acres of fee, and we hold another lease, I believe section 16, which belongs to the State. When I came here some 7 years ago, we had four operating properties, and at that time, it seemed very necessary that something drastic be done to reduce costs, in order to maintain these properties. I closed all of these mines and secured all of the tonnage from the one property. Just by way of interest to you perhaps, we had 120 miles of underground track in these four mines. Today we have less than 12 miles of underground track and produce possibly 30 percent more coal.

Congressman BARRETT. Could you tell us what percentage of the coal deposits in northeastern Wyoming the Government holds title to?

Mr. PAPE. I couldn't tell you. I do know this, that in this lease we have just taken of 1,200 acres, we have just scratched what is

behind. In other words, the Government has a good many sections of coal land immediately behind us. I would say that is practically all in this high grade quality field. However, because of our owning the approaches along the railroad, it would perhaps have to be worked from our property to be worked economically. Otherwise, they would have to approach it with roundabout railroads.

Congressman BARRETT. The Government owns a substantial acreage?

Mr. PAPE. Very substantial.

Senator O'MAHONEY. Thank you, Mr. Pape.

Senator O'MAHONEY. Mr. Knox.

**STATEMENT OF GLEN A. KNOX, GUNN-QUEALY COAL CO.,
OF SWEETWATER COUNTY, GURLEY, WYO.**

Mr. KNOX. I would like to make a brief statement in defense of southern Wyoming. I am from Sweetwater County, wherein is located approximately 75 or 80 percent of the coal mined in the State of Wyoming. We have approximately 50 feet of coal underlying most all of that coal field, in veins ranging all the way from 17 feet down to as low as is workable, and Dr. Sayers' department is fully aware of the analysis and quality of the coal. In that area, we have one of the largest gas fields of the Nation, and the boring for gas goes through the coal seams into the gas-producing sands. It has been stated today and correctly so, no doubt, that it would take approximately as much to process the coal as will be processed. This enormous gas field is producing gas today and will produce at a low cost, as low or lower than any place in the country. The domestic rate in Rocksprings is 15 cents a thousand feet. We have ample electric power and water nearby and plenty of space for a plant, and in Lincoln county they have one of the largest veins of coal, with unlimited area of low-grade lignite coal, what is known as the adac vein. Close by that is the highest grade of coal mined in the State. That is recognized by all the States, as high a grade of coal as is mined anywhere in the Rocky Mountain region—in the Kemmerer field, a condition which I do not believe exists in any other of the States discussed here today, the low-grade coal for processing, and the high-grade coal to be used for producing as much fuel as is necessary to process the coal. I hope very serious consideration will be given to that advantage in that area, and the fact southern Wyoming is quite centrally located, is available to the Utah fields, and not so far from Colorado. I see by Dr. Sayers' weekly statement that Wyoming is now producing more coal than any other State west of the Mississippi River, and at least 80 percent of that coal is being mined in that area. I am certain and satisfied in locating this plant that the site will be most carefully considered, and we are willing to leave it up to the Bureau of Mines where they will locate this plant. We know they will locate it at the best possible point.

Senator O'MAHONEY. Thank you very much, Mr. Knox.

Mr. PAPE. May I correct one statement I made, or add to it, rather. I said about the question of our selling this coal to the Government at \$1.25 a ton. In thinking it over, I realize there may be some time before the passage of this bill and the preparation and final decision to go into many things between now and then. Perhaps costs may rise, in which instance, we might have to raise our sights.

However, if wage conditions remain as at present, and even though they may raise 10 or 15 cents a ton, I have the very definite impression that America still is on the march, and, with an increase in volume, we have one cost for 1,000,000 tons, another for 2,000,000, and another for 3,000,000 and so on, and with an increase in volume that would come about through building up of tonnage of this kind, I honestly believe we are going to come down below a dollar a ton.

Senator O'MAHONEY. Mr. Sorenson, do you care to make a statement?

Mr. SORENSON. I think not, Mr. Chairman.

Senator O'MAHONEY. Mr. Sorenson is from Kemmerer, and I do not believe his lignite coal in the Kemmerer area moves in competition with the Sheridan, Wyo., coal or Utah coal for domestic purposes. It is a high-grade coal so far as heat units are concerned, 80 feet of coal which would not require washing, and is one of the cleanest veins of coal I have seen.

The committee is now drawing its hearings to a conclusion. The session in Washington began August 3. Hearings have been held in Washington, in Pittsburgh, Salt Lake City, and here in Sheridan. There has been a great deal of very lively interest displayed in the subject matter under discussion. I feel very grateful to the Chamber of Commerce of Sheridan, and to Mr. Art Sherwood, its very active and efficient secretary, for the services he has rendered to this committee. The stay of the committee in the city has been made most pleasant. I cannot let the occasion go without expressing appreciation for the presence of Senator Robertson and Congressman Barrett, who likewise have been very much interested in what we are doing. The members of the subcommittee, Senator Gurney and I, are leaving today. Senator Murdock had to leave earlier in the afternoon. They have been most diligent and attentive in the work of the committee. I do not know how it would be possible to find two committee members more active, more intelligent, and more able than these two gentlemen have been. And I want them to know, as far as Wyoming is concerned, I feel personally very grateful to them for the splendid cooperation they have rendered in this State. At the Chamber of Commerce luncheon today, I had occasion to express appreciation for the work Secretary Ickes has done, and Assistant Secretary Straus, and the staff of the Bureau of Mines. Their work has been carried on in a most satisfactory manner, and we are very grateful to them. Perhaps I should not conclude this hearing without saying that New Mexico is represented here in the person of the clerk of the Committee on Public Lands and Surveys, Mr. W. H. McMains, who is also the secretary to the very distinguished and able Senator from New Mexico, the Hon. Carl A. Hatch. We invited the Governor of New Mexico to be present. Unfortunately circumstances prevented that. If Mr. McMains cares to make a statement for New Mexico before the hearing closes, we will be glad to have him do so. I might say before he speaks, I have never known a more efficient clerk of a committee in the Senate, and we are very deeply grateful to him for the cooperation he has rendered the committee.

Mr. McMAINS. Thank you very much, Mr. Chairman. I speak now as a citizen of the State of New Mexico, not as a member of this committee. I was rather disappointed this morning when the chairman asked if a test had been made of the coal properties in New Mexico, and the reply was in the negative. I have taken the

liberty today to talk to some of our officials in New Mexico, and suggested we have presented for the hearings, a statement relative to the mining operations of New Mexico, as they might be affected by this legislation.

Senator O'MAHONEY. Dr. Schroeder is the sole remaining representative of the Bureau of Mines. I hope you will bear in mind the request.

I should also add the hearing in Sheridan has suffered by reason of the absence of Congressman Randolph, of West Virginia. It was necessary for him to leave us at Salt Lake City, and proceed to San Francisco. He has attended every other meeting of the committee on his own behalf, and on behalf of the subcommittee of the House of Representatives and has conducted an independent study into this subject. He has made a very acceptable contribution to the work.

Now, in closing the session, I want to call on the Assistant Secretary of the Interior, Mr. Straus:

Secretary STRAUS. Dr. Sayers, Dr. Fieldner, and Mr. Kraemer are all in an airplane, headed back to Washington. After a good night's sleep, they will meet there and continue their discussion tomorrow. This is why I want to speak in their behalf, as well as other representatives of the Interior Department. All of the scientific agencies and research groups of the Department have worked on this question of coal for a long time. And when an alert Senator, such as our chairman calls the scientists and research workers and says "now is the time to report", we naturally appreciate the opportunity we have had. We have gone into over half of the states of the union, several thousand miles on this trip, and with the chairman acting not only as Senator, but what our scientists would call a catalytic agent, we have received a great deal of education from the officials in the States where we have had hearings. I want to thank the chairman for that opportunity. I would like to describe the reception we have had from all of the officials of this area and from Wyoming, and Sheridan, and I would like to thank the people for the way they have received us. A description would not approach the fact, and I would like particularly to thank the efficient Secretary of the Chamber of Commerce of Sheridan for our committee here.

One word of realistic note, in closing—this bill is a very important thing, but it is only one step of a long path we have to go down. If this bill is passed, we have made a start. Then must come appropriations. Before appropriations are made, there are a number of decisions that will have to be made. Some of them will involve controversies, such as the very honest discussion we had on relative merits, on different types of coal within this area alone that will confront the Interior Department with a lot of difficult decisions, all of which we hope will be made promptly. Every effort will be made to make them and drive this work forward. I think it took something like 15 months, when we lost one resource to make any real progress in obtaining another. I think it was 15 months after Singapore fell before we produced a synthetic tire in this country, with every energy of the Government and every energy of the people driving to that end. So I will ask you all to stay with this proposal of ours until we get it into operation. Thank you. [Applause.]

Senator O'MAHONEY. I also wish to commend and give recognition to the very efficient services of Mr. Allan Sherman of the Bureau of Mines. We traveled a long way from Washington, a good part of that

travel was in the air. We came by airplane from Chicago to Salt Lake City, from Salt Lake City back to Cheyenne, then from Cheyenne, we came up here to Sheridan.

The members of the committee who have left us are already on their way back now by air, but without exception the members of the staff of the Bureau of Mines have helped this committee to make this trip a pleasant and efficient one, none has been more effective than Dr. Schroeder, who gave you his very interesting travelogue, and who was really our travel steward for most of the way.

Senator GURNEY. I want to thank the people of Sheridan before we close. I want to state first, Mr. Chairman, Senator Joe, that it has been a distinct pleasure to serve with you on this committee, and I am sure Senator Murdock also had a very enjoyable few weeks since we started on this trip. Undoubtedly, Wyoming has furnished to the Senate of the United States one of the most efficient chairmen we have on any of our committees. He is not only efficient, but he is genial. With all these good qualities, he is a fine fellow to get along with. The people of Sheridan have been immeasurable in the hospitality and good cheer they have shown the committee since we arrived yesterday. I am certainly glad to say I have enjoyed myself immensely on my first trip to Sheridan, and I hope it won't be the last.

Senator O'MAHONEY. Thank you very much, Senator Gurney.

Let me say, it is with much regret that I call this session to an end.

(Following is a statement submitted by Dr. J. L. Morrill, President, University of Wyoming.)

THE UNIVERSITY OF WYOMING,
Laramie, Wyo., August 13, 1943.

HON. JOSEPH C. O'MAHONEY,
United States Senator, Cheyenne, Wyo.

MY DEAR SENATOR O'MAHONEY: President Morrill was unable to attend the hearing at Sheridan on the bill to provide experimental work in the production of gasoline from coal. However, he prepared a statement to be presented at the hearing and sent it to me in order that it might be presented at the hearing by Dr. Thomas. I was unexpectedly out of town when the letter arrived and owing to a slip-up in my office, it was not transmitted to Sheridan. Therefore, I am sending you a copy with the hope that there is still time to include it in the record of the hearings.

Along with others of the university who are interested in the scientific and industrial progress of Wyoming, I am very hopeful that an experimental plant will be established in Wyoming.

Very truly yours,

J. A. HILL, *Executive Dean.*

STATEMENT BY J. L. MORRILL, PRESIDENT, THE UNIVERSITY OF WYOMING, FOR UNITED STATES SENATE SUBCOMMITTEE HEARING, SHERIDAN, WYO., AUGUST 12, 1943

The University of Wyoming expresses its urgent interest in the bill, S. 1243, introduced by the Honorable Joseph C. O'Mahoney, and the earnest hope that the bill may be enacted into law.

To the United States Bureau of Mines, the university pledges the fullest cooperation of its engineering and scientific departments and of the Research Institute recently made possible at the university by action and appropriation of the Wyoming Legislature for the development and exploitation of Wyoming natural resources.

As an evidence of such cooperation, the University of Wyoming has already appropriated funds for the construction of a small addition to the space and facilities of the United States Bureau of Mines Petroleum Experiment Station on the University campus at Laramie; and the board of trustees has offered to deed to the Federal Government whatever lands may be required as the site for a new station building when and if the Congress shall make appropriation for such new

building. This precedent, indeed, suggests the possible advisability of consideration by the United States Bureau of Mines, of locating the projected new demonstration and extraction experimental plant at the university in Laramie, provided S. 1243 is enacted into law. The university is the established scientific center of the State. Its research facilities and personnel can be relied upon for assistance. It is already the site of the present efficient Petroleum Experiment Station of the Bureau.

Regardless, however, of such location the University of Wyoming which is already pledged to experimentation and development of Wyoming natural resources will give its fullest cooperation to the Federal Government and to whatever Wyoming community may be ultimately designated as the research and experimental center best adapted to realize the purposes of the bill sponsored by Senator O'Mahoney.

The war-accelerated depletion of liquid-fuel reserves foreshadows a crisis in American industry and the national economy. The physical resources to repair this shortage are available in abundance. Scientific research and engineering experimentation are the critical requirement for their utilization. S. 1243 will enable the joint mobilization of Federal and State leadership, cooperating with industry and individuals in Wyoming, to protect and promote the property of the Nation.

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Post Office Department is within the quota set by that Bureau under dates of July 29 and August 25, 1943, for each of the appropriation units involved; to the Committee on the Civil Service.

686. A letter from the Director, Selective Service System, transmitting a second list of registrants who have been deferred because of their employment in or under the Federal Government as of June 15, 1943, in accordance with the provisions of subsection C of Public Law No. 23, Seventy-eighth Congress, approved April 8, 1943; to the Committee on Military Affairs.

687. A letter from the Acting Secretary of War, transmitting reports on War Department contracts, in excess of \$150,000, let during fiscal year 1943; to the Committee on Military Affairs.

688. A letter from Alfred Tawresey, captain, United States Navy, transmitting report showing the name, age, legal residence, rank, branch of service, with special qualifications therefor, of each person commissioned from civilian life in the Navy from May 30, 1943, to July 29, 1943, and in the Marine Corps and Coast Guard from June 1 to July 31, 1943; to the Committee on Naval Affairs.

689. A letter from the Director, Selective Service System, transmitting a supplementary list of registrants who have been deferred because of their employment in or under the Federal Government as of June 15, 1943, in accordance with the provisions of subsection C of Public Law No. 23, Seventy-eighth Congress, approved April 8, 1943 (list prepared from reports submitted in the Territories of Alaska, Hawaii, and Puerto Rico); to the Committee on Military Affairs.

690. A letter from the Director, Selective Service System, transmitting the third monthly list of registrants who have been deferred because of their employment in or under Federal Government as of July 15, 1943 (list prepared from reports submitted in the continental United States and the Territories of Alaska, Hawaii, and Puerto Rico); to the Committee on Military Affairs.

691. A letter from the Acting Secretary of War, transmitting a report dated April 3, 1943, from the Chief of Engineers, United States Army, together with accompanying papers, on a review of reports on Pensacola Harbor, Fla.; to the Committee on Rivers and Harbors.

692. A letter from the Secretary of War, transmitting a report dated March 18, 1943, from the Chief of Engineers, United States Army, together with accompanying papers on a preliminary examination and survey of Miami River and tributaries, Ohio, authorized by the Flood Control Act approved on June 28, 1938; to the Committee on Flood Control.

693. A letter from the Secretary of War, transmitting an interim report dated October 26, 1942, from the Chief of Engineers, United States Army, together with accompanying papers, on a review of reports on the Detroit River, Mich., concerning only that portion known as the American Channel north of Belle Isle, between Windmill Point and Fairview Slip, Detroit, Mich.; to the Committee on Rivers and Harbors.

694. A letter from the Attorney General, transmitting a draft of a proposed bill to limit compensation for services in connection with certain claims against the United States; to the Committee on Claims.

695. A letter from the Secretary of State, transmitting a draft of a proposed bill to implement the jurisdiction of service courts of friendly foreign forces within the United States, and for other purposes; to the Committee on the Judiciary.

696. A letter from the Acting Administrator, Federal Security Agency, transmitting a second revised form of quarterly estimate of personnel requirements, for "Salaries and expenses, community war services," for the quarter ending September 30, 1943; also some

revised quarterly estimates of personnel requirements for the Public Health Service for the quarter ending September 30, 1943; to the Committee on the Civil Service.

697. A letter from the Assistant Superintendent, National Park Service, Department of the Interior, transmitting report of Federal Civilian Employment for the Executive Mansion and Grounds for the month of August 1943; to the Committee on the Civil Service.

698. A letter from the Administrator, Federal Security Agency, transmitting information forwarded to the Director of the Bureau of the Budget, showing the number of employees required for the proper and efficient exercise of the functions of various constituent organizations of the Federal Security Agency; to the Committee on the Civil Service.

699. A letter from the Acting Secretary of the Navy, transmitting a draft of a proposed bill to amend the act approved January 16, 1936, entitled "An act to provide for the retirement and retirement annuities of civilian members of the teaching staff at the United States Naval Academy and the Postgraduate School, United States Naval Academy;" to the Committee on Naval Affairs.

700. A letter from the Acting Administrator, Federal Security Agency, transmitting the Fourth Quarterly Report of the United States Commissioner of Education on the Education and Training of Defense Workers, covering the period beginning April 1, 1943, and ending June 30, 1943; to the Committee on Appropriations.

701. A letter from the Acting Secretary of the Interior, transmitting the report covering activities under the Federal aid to wildlife-restoration fund for the fiscal year ended June 30, 1943; to the Committee on Agriculture.

702. A letter from the Acting Secretary of the Interior, transmitting one copy each of various legislation passed by the Municipal Council of St. Thomas and St. John; to the Committee on Insular Affairs.

703. A letter from the Acting Secretary of the Interior, transmitting one copy each of various legislation passed by the Municipal Council of St. Croix; to the Committee on Insular Affairs.

704. A letter from the Acting Secretary of the Interior, transmitting a copy of Resolution No. 35, to provide for the construction of post-war plans for the Virgin Islands, which was passed by the Municipal Council of St. Thomas and St. John on March 27, 1943; to the Committee on Insular Affairs.

705. A letter from the Acting Administrator, Federal Security Agency, transmitting a detailed statement of receipts and expenditures for St. Elizabeths Hospital for the fiscal year ending June 30, 1943; to the Committee on Expenditures in the Executive Departments.

706. A communication from the President of the United States, transmitting a supplemental estimate of appropriation for the Treasury Department for the fiscal year 1944, amounting to \$250,000 (H. Doc. No. 265); to the Committee on Appropriations and ordered to be printed.

707. A letter from the Secretary of War, transmitting a letter from the Chief of Engineers, United States Army, dated May 4, 1943, forwarding a report, together with accompanying papers and illustrations, on a survey of the Ohio River and its tributaries for pollution control, authorized by section 5 of the River and Harbor Act approved August 26, 1937 (H. Doc. No. 266); to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

REPORTS OF COMMITTEES ON PRIVATE BILLS AND RESOLUTIONS

Under clause 2 of rule XIII, reports of committees were delivered to the Clerk

for printing and reference to the proper calendar, as follows:

Mr. LESINSKI: Committee on Immigration and Naturalization. H. R. 312. A bill for the relief of Freda Utley; without amendment (Rept. No. 700). Referred to the Committee of the Whole House.

Mr. DICKSTEIN: Committee on Immigration and Naturalization. H. R. 2131. A bill for the relief of Henry Angell; without amendment (Rept. No. 701). Referred to the Committee of the Whole House.

Mr. LESINSKI: Committee on Immigration and Naturalization. H. R. 2509. A bill for the relief of Marie Engert; without amendment (Rept. No. 702). Referred to the Committee of the Whole House.

Mr. DICKSTEIN: Committee on Immigration and Naturalization. H. R. 2902. A bill for the relief of Mrs. William Leo; without amendment (Rept. No. 703). Referred to the Committee of the Whole House.

CHANGE OF REFERENCE

Under clause 2 of rule XXII, the Committee on Invalid Pensions was discharged from the consideration of the bill (H. R. 3115) granting a pension to Mrs. Julia Hinton, and the same was referred to the Committee on World War Veterans' Legislation.

PUBLIC BILLS AND RESOLUTIONS

Under clause 3 of rule XXII, public bills and resolutions were introduced and severally referred as follows:

By Mrs. BOLTON:

H. R. 3196. A bill to provide insignia for persons discharged from the armed forces of the United States because of disabilities not due to their own misconduct; to the Committee on Military Affairs.

By Mr. COLE of New York:

H. R. 3197. A bill to make title VIII of Public Law 753 of the Seventy-seventh Congress entitled "Renegotiation of War Contracts," as amended, inoperative as to future war contracts; to the Committee on Ways and Means.

H. R. 3198. A bill to prohibit unauthorized agreements with foreign nations; to the Committee on Foreign Affairs.

H. R. 3199. A bill to authorize the appropriation, for expenditure by the Office of Foreign Relief and Rehabilitation Operations, of certain amounts received from services of conscientious objectors; to the Committee on Military Affairs.

By Mr. PATMAN:

H. R. 3200. A bill to provide certain benefits for members of the armed forces upon their discharge or release from active duty, to provide for the use and disposition of surplus war property in the interests of small business enterprises of veterans and others, and for other purposes; to the Committee on Ways and Means.

By Mr. FULMER:

H. R. 3201. A bill providing for the transfer to the custody and control of the Secretary of the Navy of certain lands comprising a portion of Croatan National Forest in the State of North Carolina; to the Committee on Agriculture.

By Mr. GROSS:

H. R. 3202. A bill providing for the deferment of fathers until certain prisoners have been inducted; to the Committee on Military Affairs.

By Mr. HEIDINGER:

H. R. 3203. A bill to prohibit the fixing of a maximum price of less than \$2 per barrel on crude petroleum; to the Committee on Banking and Currency.

By Mr. LYNCH:

H. R. 3204. A bill to establish and provide for a system of old-age and survivors insurance for employees of religious, charitable, educational, and certain other organizations, and for other purposes; to the Committee on Ways and Means.

By Mr. MAY:

H. R. 3205. A bill to provide for the deferment of fathers from training and service under the Selective Training and Service Act of 1940, as amended, and for other purposes; to the Committee on Military Affairs.

By Mrs. NORTON:

H. R. 3206. A bill to amend the act entitled "An act to expedite the provision of housing in connection with national defense, and for other purposes," approved October 14, 1940, as amended; to the Committee on Public Buildings and Grounds.

By Mr. RANDOLPH:

H. R. 3207. A bill to provide for the inspection and registration of bicycles in the District of Columbia; to the Committee on the District of Columbia.

H. R. 3208. A bill to permit construction, maintenance, and use of certain pipe lines for steam-heating purposes in the District of Columbia; to the Committee on the District of Columbia.

H. R. 3209. A bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes; to the Committee on Mines and Mining.

By Mr. SABATH:

H. R. 3210. A bill to extend to certain civilians abroad the provisions of law prescribing a special method for voting now applicable to members of the armed forces in time of war, and for other purposes; to the Committee on Election of President, Vice President, and Representatives in Congress.

By Mr. WELCH:

H. R. 3211. A bill relating to the induction of registrants who applied and who were accepted for induction and assigned to educational institutions for special and technical training under the provisions of the act approved August 31, 1918, but whose induction without fault of their own was not completed; to the Committee on Military Affairs.

By Mr. DICKSTEIN:

H. J. Res. 154. Joint resolution to provide for the temporary admission into the United States of political or religious refugees from the Axis Nations; to the Committee on Immigration and Naturalization.

By Mr. JARMAN:

H. Res. 300. Resolution authorizing the printing of a revised edition of the manuscript entitled "Handbook for Servicemen and Servicewomen, World War II, and Their Dependents", as a public document, and providing for additional copies thereof; to the Committee on Printing.

MEMORIALS

Under clause 3 of rule XXII, memorials were presented and referred as follows:

By the SPEAKER: Memorial of the Legislature of the State of Alabama, memorializing the President and the Congress of the United States to amend the Constitution relative to paying of taxes; to the Committee on the Judiciary.

Also, memorial of the Legislature of the State of Wisconsin, memorializing the President and the Congress of the United States to amend the Constitution relative to the income-tax law; to the Committee on the Judiciary.

Also, memorial of the Legislature of the State of Wisconsin, memorializing the President and the Congress of the United States to amend the Constitution relative to taxes

on incomes; to the Committee on the Judiciary.

Also, memorial of the Chamber of Deputies of Peru, relative to the Independence Day and definite triumph over the German-Italian-Japanese triumvirate; to the Committee on Foreign Affairs.

Also, memorial of the Legislature of the State of Indiana, memorializing the President and the Congress of the United States to limit the term of the President of the United States to not more than two consecutive terms; to the Committee on Election of President, Vice President, and Representatives in Congress.

Also, memorial of the Legislature of the State of Wisconsin, memorializing the President and the Congress of the United States to take necessary steps to remove restrictions on corn acreage and to encourage an expanded production of corn; to the Committee on Banking and Currency.

Also, memorial of the Legislature of the Territory of Puerto Rico, memorializing the President and the Congress of the United States to establish a republic of Puerto Rico; to the Committee on Insular Affairs.

Also, memorial of the Dodecanesian Unions in Egypt, memorializing the President and the Congress of the United States that the ardent desire of the inhabitants of the Dodecanese is to be united with their motherland, Greece; to the Committee on Foreign Affairs.

Also, memorial of the Legislature of the Territory of Hawaii, memorializing the President and the Congress of the United States with a report on rent control in the city and county of Honolulu, T. H., to the Committee on Banking and Currency.

Also, memorial of the Legislature of the Republic of Costa Rica, memorializing the President and the Congress of the United States with a cordial sympathy and continental solidarity to the House of Representatives of the United States of America; to the Committee on Foreign Affairs.

Also, memorial of the Legislature of the Territory of Puerto Rico, memorializing the President and the Congress of the United States to establish the independence of Puerto Rico; to the Committee on Insular Affairs.

PRIVATE BILLS AND RESOLUTIONS

Under clause 1 of rule XXII, private bills and resolutions were introduced and severally referred as follows:

By Mr. BARRY:

H. R. 3212 (by request). A bill for the relief of Amelia A. Mannshardt; to the Committee on Claims.

By Mr. BLOOM:

H. R. 3213. A bill for the relief of Ludwig Bial, Grete Bial, Ernest Bial, and Ottilie Bial; to the Committee on Immigration and Naturalization.

H. R. 3214. A bill for the relief of certain officers and employees of the Foreign Service of the United States who, while in the course of their respective duties, suffered losses of personal property by reason of war conditions; to the Committee on Foreign Affairs.

By Mr. COLE of New York:

H. R. 3215. A bill granting an increase of pension to Forrest E. Andrews; to the Committee on Pensions.

By Mr. LUDLOW:

H. R. 3216. A bill granting an increase of pension to Frances A. Bruce; to the Committee on Invalid Pensions.

H. R. 3217. A bill for the relief of Claribel Moore; to the Committee on Claims.

H. R. 3218. A bill for the relief of Enid M. Albertson; to the Committee on Claims.

H. R. 3219. A bill providing for the payment to Yatie Fowler of money due on account of Civil War service of her grandfather, George W. Allison; to the Committee on Claims.

H. R. 3220. A bill granting an increase of pension to Catherine J. Wilson; to the Committee on Invalid Pensions.

By Mr. O'BRIEN of New York:

H. R. 3221. A bill for the relief of Ponogetis Vassiliou; to the Committee on Immigration and Naturalization.

By Mr. WOLCOTT:

H. R. 3222. A bill for the relief of Mrs. Margaret McWilliams; to the Committee on Claims.

PETITIONS, ETC.

Under clause 1 of rule XXII, petitions and papers were laid on the Clerk's desk and referred as follows:

2108. By Mr. COCHRAN: Petition of Dominic Streff and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2109. Also petition of Thomas V. Carrens, president, U. A. W. A., C. I. O., Local 986, St. Louis, Mo., and other St. Louis citizens, protesting against the passage of House bill 2802, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2110. Also petition of Joseph Langen and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2111. Also petition of Wolff Tober Shoe Co. and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2112. Also, petition of Mrs. E. Hiesler and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2113. Also petition of George W. Kutter and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2114. Also petition of Robert W. Cutty and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2115. Also petition of H. McCormick and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2116. Also petition of Herman Stamm and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2117. Also petition of William M. Yates and other St. Louis citizens, protesting against the passage of House bill 2082, which seeks to enact prohibition for the period of the war; to the Committee on the Judiciary.

2118. By Mr. LYNCH: Resolution of the Board of Aldermen of the City of Burlington, Vt., supporting legislation to provide for a ship canal between deep water in Hudson River at Albany, N. Y., and deep water at Crown Point, N. Y.; to the Committee on Rivers and Harbors.

2119. By Mr. GRAHAM: Petition of 47 members and adherents of the United Presbyterian Church of New Bedford, Pa., requesting the passage of all bills now before the House to prohibit the advertising of alcoholic beverages, to ban beer and liquor sales at military and naval centers, to make it unlawful to furnish alcoholic beverages to anyone in uniform, and to prohibit the manufacture, sale, and transportation of all alcoholic beverages for the duration of the war; to the Committee on Military Affairs.

78TH CONGRESS
1ST SESSION

H. R. 3209

IN THE HOUSE OF REPRESENTATIVES

SEPTEMBER 14, 1943

Mr. RANDOLPH introduced the following bill; which was referred to the Committee on Ways and Means

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

- 1 *Be it enacted by the Senate and House of Representa-*
- 2 *tives of the United States of America in Congress assembled,*
- 3 That the Secretary of the Interior, acting through the Bureau
- 4 of Mines, within the limits of critical materials available, is
- 5 authorized to construct, maintain, and operate one or more
- 6 demonstration plants to produce synthetic liquid fuels from
- 7 coal and other substances with all facilities and accessories

1 for the manufacture, purification, storage, and distribution
2 of the products.

3 SEC. 2. In order to carry out the purpose of this Act,
4 the Secretary of the Interior is authorized—

5 (a) to conduct laboratory research and develop-
6 ment work necessary to determine the best demonstra-
7 tion plant designs and conditions of operation;

8 (b) to acquire, by purchase, lease for a term of
9 years or less, donation, or otherwise, land, and any in-
10 terest in land, including easements and lease-hold inter-
11 ests; options on real or personal property; plants and
12 their facilities; secret processes, technical data, inven-
13 tions, patent applications, patents, irrevocable nonexclu-
14 sive licenses, and other rights and licenses under patents
15 granted by this or any other nation; to assume the obli-
16 gation to pay rentals in advance on property so acquired,
17 and to pay damages arising out of the use of any such
18 property;

19 (c) to engage, by contract or otherwise, engineers,
20 architects, and any private industrial organization he
21 deems suitable, to do all or any part of the work of de-
22 signing, constructing, or operating the plants, the oper-
23 ation to be under his supervision, and through leases or
24 otherwise as he believes advisable;

25 (d) to cooperate with any other Federal or State

department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this Act.

Sections 321 and 322 of the Act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State Government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this Act, and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act.

SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall

1 render to Congress on or before the 1st day of January of
 2 each year a report of all operations under this Act.

3 SEC. 5. The Secretary of the Interior may issue rules
 4 and regulations to effectuate the purposes of this Act. The
 5 authority and duties of the Secretary of the Interior under this
 6 Act shall be exercised through the Bureau of Mines of the
 7 Department of the Interior.

78TH CONGRESS
 1ST SESSION

H. R. 3209

A BILL

Authorizing the construction and operation of
 demonstration plants to produce synthetic
 liquid fuels from coal and other substances,
 in order to aid the prosecution of the war,
 to conserve and increase the oil resources of
 the Nation, and for other purposes.

By Mr. RANDOLPH

SEPTEMBER 14, 1943

Referred to the Committee on Ways and Means



United States
of America

Congressional Record

PROCEEDINGS AND DEBATES OF THE 78th CONGRESS, FIRST SESSION

Vol. 89

WASHINGTON, WEDNESDAY, OCTOBER 6, 1943

No. 147

House of Representatives

[The House was not in session today. Its next meeting will be held on Thursday, October 7, 1943, at 12 o'clock noon.]

Senate

WEDNESDAY, OCTOBER 6, 1943

(Legislative day of Wednesday, September 15, 1943)

The Senate met at 11 o'clock a. m., on the expiration of the recess.

The Chaplain, Rev. Frederick Brown Harris, D. D., offered the following prayer:

Eternal Spirit who dost bring forth Thy righteousness as the light and Thy judgments as the noonday, in the presence of the ageless realities we pause in reverence and with a deep sense of responsibility as servants of the public weal, praying for courage to attempt, power to achieve, patience to endure. In this pavilion of peace above the confusion of tongues we would commit our way unto Thee, fretting not ourselves because of the men who bring wicked devices to pass, knowing that evildoers shall be cut off but that those who wait upon the Lord shall inherit the earth. Forbid that in this solemn hour when great clocks of destiny are striking we whose is the birthright of the democratic tradition should meet the world's spiritual crisis with blind unbelief, blighting cynicism, and timid unwillingness to make decisions in time and together.

We pray not for man's victory over man, but for the triumph of Thy kingdom in all the world as we fight on, with the fire of our ruling passion burning, not because we loathe the same evils, but because we love the same God who is the Father of all men. We ask it in the Redeemer's name. Amen.

THE JOURNAL

On request of Mr. HILL, and by unanimous consent, the reading of the Journal of the proceedings of the calendar day Tuesday, October 5, 1943, was dispensed with, and the Journal was approved.

CALL OF THE ROLL

Mr. HILL. I suggest the absence of a quorum.

The VICE PRESIDENT. The clerk will call the roll.

The Chief Clerk called the roll, and the following Senators answered to their names:

Alken	Green	Overton
Andrews	Guffey	Pepper
Austin	Gurney	Radcliffe
Bailey	Hatch	Reed
Ball	Hawkes	Revercomb
Barbour	Hayden	Reynolds
Barkley	Hill	Robertson
Brewster	Holman	Russell
Bridges	Johnson, Calif.	Shipstead
Brooks	Johnson, Colo.	Stewart
Buck	Kilgore	Taft
Bushfield	Langer	Thomas, Idaho
Butler	Lodge	Thomas, Okla.
Capper	Lucas	Thomas, Utah
Caraway	McCarran	Tunnell
Chandler	McClellan	Tydings
Chavez	McFarland	Vandenbergh
Clark, Idaho	McKellar	Van Nuys
Clark, Mo.	McNary	Wagner
Connally	Maloney	Wallgren
Danaher	Maybank	Walsh
Davis	Millikin	Wheeler
Eastland	Moore	White
Ellender	Murdock	Wiley
Ferguson	Murray	Willis
George	Nye	Wilson
Gerry	O'Daniel	
Gillette	O'Mahoney	

Mr. HILL. I announce that the Senator from Washington [Mr. BONE], the Senator from Virginia [Mr. GLASS], and the Senator from South Carolina [Mr. SMITH] are absent from the Senate because of illness.

The Senator from Missouri [Mr. TRUMAN] is absent on official business for the Special Committee to Investigate the National Defense Program.

The Senator from California [Mr. DOWNEY] is absent on official business for the Special Committee to Investigate Labor Conditions on the West Coast.

The Senator from Alabama [Mr. BANKHEAD], the Senator from Mississippi [Mr. BILBO], and the Senator from Nevada [Mr. SCRUGHAM] are detained on important public business.

The Senator from Virginia [Mr. BYRD] and the Senator from New York [Mr. MEAD] are necessarily absent.

Mr. McNARY. The Senator from New Hampshire [Mr. BRIDGES] is necessarily absent.

The senior Senator from Wisconsin [Mr. LA FOLLETTE] has been confined to a Madison hospital since September 13.

The Senator from New Hampshire [Mr. TOBEY] is necessarily absent on official appointments.

The Senator from Nebraska [Mr. WHERRY] is absent because of illness.

The VICE PRESIDENT. Eighty-two Senators have answered to their names. A quorum is present.

PERSONNEL REQUIREMENTS, OFFICE OF ALIEN PROPERTY CUSTODIAN

The VICE PRESIDENT laid before the Senate a letter from the Alien Property Custodian, submitting, pursuant to law, an estimate of personnel requirements of his office for the quarter ending December 31, 1943, which, with the accompanying paper, was referred to the Committee on Civil Service.

PETITION TO SAVE THE JEWS IN NAZI-CONTROLLED EUROPE—APPEAL BY THE RABBIS OF AMERICA

The VICE PRESIDENT laid before the Senate the petition and appeal of the rabbis of America for the adoption of immediate and practical measures to rescue and save the Jewish people from persecution in Nazi-controlled Europe, which was referred to the Committee on Foreign Relations and ordered to be printed in the RECORD, as follows:

OCTOBER 6, 1943.

To the Honorable HENRY AGARD WALLACE,
Vice President of the United States:

In the name of God, creator of the universe, blessed be He, who voiced in our Holy

Torah the command: "Thou shalt not stand idly by the blood of your neighbor. I am the Lord."

In this hour of our distress we call upon the Almighty, Lord of heaven and earth in the ancient words: "A voice on high is heard, the voice of our brothers' blood—innocent souls by the tens of thousands, children, infants, and sucklings—the aged, men and women, cry out unto us: 'Save us!'"

How can we face the Lord on the hallowed day, the Day of Atonement, knowing that we have not fulfilled our duty? And on the eve of this day most holy to us, we come broken-hearted to ask you, Mr. Vice President, to hear the cries of our brethren, now in the hands of the murderous Nazi government which singled out the people of Israel as its target and has decreed their annihilation and oblivion. The Nazis have poured out their rage against our people with a horrible cruelty unequalled by the savages of ancient days. Millions of Jews have already fallen, exterminated with fire and sword; tens of thousands have died of starvation and have been victims of barbarous and unnatural executions.

In view of this tragic emergency, it is a holy obligation to take drastic steps to save the Jewish people:

1. To adopt immediate and practical measures of rescue and to use all possible means to end the murders committed by Nazi criminals.
2. To warn Germany and all the Nazi-satellite countries that every atrocity and crime perpetrated against their Jewish residents, whether by governments or private individuals, will be held against them and that, likewise, every act of kindness toward these unfortunates will not pass unnoticed.
3. To send ships with food and medical supplies to the Jews starving in ghettos, which will be distributed under the supervision of a neutral commission or through the International Red Cross.
4. To influence and persuade neutral countries to allow the Jewish refugees who flee from the Nazi sword to seek security within their borders and to guarantee to these countries the means for the temporary maintenance of these refugees.
5. To open the gates of the United Nations to provide havens therein, and to facilitate the entry into our land, the United States of America, of those who can escape the Nazi terror.

6. To open immediately to these refugees the doors of Palestine, the Holy Land of our forefathers, which was given to Israel for eternal heritage by the Lord, blessed be His name, with oath and covenant.

7. To create a special intergovernmental agency to save the remnant of Israel in Europe with powers and means to act at once on a large scale.

We pray and appeal to the Lord, blessed be He, that our most gracious Vice President, HENRY AGARD WALLACE, consider and recognize this momentous hour of history and the responsibility which the Divine Presence has laid upon the leaders of this great Nation that they may save the remnant of the People of the Book. And we pray that the Lord may aid us to gain complete and speedy victory on all fronts against our enemies and that we may be blessed with everlasting peace. And we shall pray on the day of atonement for the triumph of our country, the United States of America. Amen.

RABBI ISRAEL ROSENBERG,
President, Union of Orthodox Rabbis of the United States.

RABBI L. B. LEVINTHAL,
President, Union of Orthodox Rabbis of the United States.

RABBI JUDA L. SELTZER,
Executive Director, Union of Orthodox Rabbis of the United States.

RABBI WOLF GOLD,
Member Executive Committee, Union of Orthodox Rabbis of the United States, and Honorary President, American Mizrahi Organization.

RABBI ELIEZER SILVER,
President, Union of Orthodox Rabbis of the United States, and President, American Agudas Israel.

RABBI HAIM I. BLOCH,
Vice President, Union of Orthodox Rabbis of the United States.

RABBI REUBEN LEVOWITZ,
Secretary, Union of Orthodox Rabbis of the United States.

RABBI SOLOMON M. FRIEDMAN,
President, Union of Grand Rabbis of the United States.

REPORTS OF COMMITTEE ON MILITARY AFFAIRS

The following reports of a committee were submitted:

By Mr. JOHNSON of Colorado, from the Committee on Military Affairs:

S. 771. A bill to provide for payment of pensions and compensation to certain persons who are receiving retired pay; with an amendment (Rept. No. 446); and

H. R. 693. A bill to amend the Pay Readjustment Act of 1942, approved June 16, 1942; without amendment (Rept. No. 447).

SYNTHETIC LIQUID FUELS—REPORT OF COMMITTEE ON PUBLIC LANDS AND SURVEYS

Mr. O'MAHONEY. Mr. President, from the Committee on Public Lands and Surveys I ask unanimous consent to report, with amendments, the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, and to submit a report (No. 445) thereon. I also ask unanimous consent that the committee report and bill as proposed to be amended be printed in the RECORD.

The VICE PRESIDENT. Without objection, the report will be received and the bill will be placed on the calendar; and the report and bill will be printed in the RECORD as requested by the Senator from Wyoming.

The committee report and bill, as proposed to be amended by the Committee on Public Lands and Surveys, are as follows:

The Committee on Public Lands and Surveys, to whom was referred the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having carefully considered the same, report favorably thereon with the following amendments and with the recommendation that the bill, as amended, do pass.

On page 2, line 2, after the word "products", add the following: "The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products."

On page 3, line 16, after the word "purchaser", strike out the period and add the following: "through regular commercial channels."

This bill might well be termed "a bill to assure the United States a continuous supply of domestically produced motor fuel and aviation gasoline." The military demands for petroleum and its products during the war have been so great that we are now burning up liquid fuel at the rate of approximately 1,500,000,000 barrels of crude oil every year. This tremendous drain upon American supplies has been occasioned by the fact that the United States oil fields have been the only sure and certain source of supply for the armies, the navies, and the air forces of all the United Nations. Even though the recovery of the Mediterranean Sea from Axis control is opening up middle-eastern sources of oil, the demand for American supplies is likely to continue at a tremendously high rate because the American air fleets are being constantly augmented. More and larger planes of longer flying radius are under construction and the demand for these planes will not be appreciably diminished while the war with Japan continues.

The consumption of oil in the United States is now proceeding annually at a rate much greater than the discovery of new supplies. During the years 1940, 1941, and 1942, the additions to the proven oil reserves of the Nation amounted in the aggregate to approximately 1,600,000,000 barrels of crude oil as compared with additions of 5,400,000,000 barrels in the preceding 3 years. The rate of discovery has been steadily declining and while your committee is of the opinion that the search for oil in the public-land States can be successfully stimulated, it is nevertheless evident that the demand for liquid fuel is likely to continue at such a high rate that the Nation's interest can be conserved only by immediate action to bring about the manufacture of synthetic fuel from the unlimited supplies of coal which this country possesses and from the vast deposits of oil shale to be found in several of the public-land States.

There can be no doubt now that aviation will be one of the principal industries toward which the world will turn after the war. The United States now occupies a position of world leadership in this field. Not only because of the genius and skill of its citizens who are engaged in the design and manufacture of airplanes, but because we have had a large supply of crude oil. If, however, the country is to maintain its leadership in the air it must take steps now to guarantee a sure and certain supply of liquid fuel. This can be done by the use of coal, oil shale, and other materials for the manufacture of synthetic liquid fuels. In Germany, Japan, and in England, also, the hydrogenation of coal has been a source of gasoline supply. The process has not been used in the United States largely because of the cost; and industry has not as yet undertaken to demonstrate the possibilities.

The Bureau of Mines, acting under the authorization of a special appropriation has made experiments in a small plant at the Bureau of Mines Station in Pittsburgh, Pa. These experiments, which have been successfully carried out, have proceeded to such a point that it is now desirable to carry them on in a more extensive manner. The Pittsburgh tests were scarcely more than laboratory tests; the next step is to construct and operate demonstration plants.

The committee held hearings during the recess of Congress at Washington, D. C., Pittsburgh, Pa., Salt Lake City, Utah, and Sheridan, Wyo. Opportunity was extended to all branches of industry to discuss the measure. The response, not only from industry but also from public authorities in the coal-bearing States, was little short of enthusiastic. Only

one doubt was expressed, namely, that the authority might be used to put the Government in competition with private industry. This was not the intention of the sponsor of the bill, nor of the Department of the Interior, and statements to that effect were made at the hearings. In order to make the matter clear, however, the committee, at the recommendation of the subcommittee which conducted the hearings, has adopted the amendments on pages 2 and 3 of the bill which are set forth in full above, to make certain that there will be no invasion of the domain of private industry and no competition by Government with commercial enterprise.

The report of the Secretary of the Interior is hereinbelow set forth in full and made a part of this report:

MY DEAR SENATOR HATCH: You have asked my views on the provisions of S. 1243, a bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

I am wholeheartedly in favor of the legislation proposed in the bill. It is high time that the country embarked in earnest upon the program of research and development work necessary to determine the processes and equipment required for the establishment of an industry which can help to supply the continuing needs of the country for liquid fuels which have heretofore been available from the ample but now waning domestic petroleum reserves.

The total demand for liquid fuel in 1941 and 1942 reached about 1,500,000,000 barrels annually. The rate of discovery of petroleum has decreased sharply since 1937. In the 3 years 1937-39 about 5,400,000,000 barrels were added to the Nation's proved oil reserves, whereas in the 3 years 1940-42 the increment was only 1,600,000,000 barrels. In 1942 the new reserves discovered, including extensions and new horizons in old fields, were at a low of 317,000,000 barrels or only about one-fifth of our annual rate of consumption. This failure to find adequate quantities of new oil was not due to lack of prospect drilling, as 3,264 wildcat wells were drilled in 1941 and 3,029 in 1942.

The decline in the rate at which new discoveries are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The ominous implications of the progressive effect of this decline upon the peacetime economy of the post-war years are easily foreseen and can be effectively forestalled by timely action. The answer to the problem clearly lies in the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

It is apparent that this country can no longer delay in embarking upon a synthetic liquid-fuel program. Our study of petroleum reserves and the rate of their depletion indicates clearly that unless we take action, the end of the age of abundant oil is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, the Department of the Interior has been aware of these trends and has initiated the study of means which may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

However, the time has come when we must get out of the test-tube stage into actual production. Past experiments have

given us the scientific knowledge of the basic processes involved, but the way must be blazed for American industry to enter this synthetic fuel field, which inevitably will be one of the major industrial developments of the near future.

It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly.

Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up the work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that private enterprise can take up the task of providing synthetic fuels on the scale necessary to safeguard the Nation's future.

The Department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

Sincerely yours,

HAROLD L. ICKES,
Secretary of the Interior.

Be it enacted, etc., That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid-fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

SEC. 2. In order to carry out the purpose of this act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, donation, or otherwise, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this act. Sections 321 and 322 of the act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this act, and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this act.

SEC. 4. All moneys received under this act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the 1st day of January of each year a report of all operations under this act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this act. The authority and duties of the Secretary of the Interior under this act shall be exercised through the Bureau of Mines of the Department of the Interior.

BILLS INTRODUCED

Bills were introduced, read the first time, and, by unanimous consent, the second time, and referred as follows:

By Mr. WILLIS:

S. 1416. A bill for the relief of Mrs. Judith H. Seder; to the Committee on Claims.

(Mr. HATCH introduced Senate bill 1417, which was referred to the Committee on Public Lands and Surveys, and appears under a separate heading.)

(Mr. EASTLAND (for himself and Mr. McCLELLAN) introduced Senate bill 1418, which was referred to the Committee on Agriculture and Forestry, and appears under a separate heading.)

By Mr. PEPPER:

S. 1419. A bill to authorize collectors of internal revenue to receive cashier's checks of certain banking institutions in payment for revenue stamps; to the Committee on Finance.

By Mr. McCARRAN:

S. 1420. A bill providing for the reorganization of the Government of the District of Columbia, and for other purposes; to the Committee on the District of Columbia.

TELEPHONE AND TELEGRAPH BUILDING, ANCHORAGE, ALASKA

Mr. HATCH. Mr. President, I ask unanimous consent to introduce a bill for appropriate reference, and in connection therewith I request that a letter from the Secretary of the Interior dated September 22, 1943, be printed in the RECORD.

There being no objection, the bill (S. 1417) to authorize the Secretary of the Interior to donate and convey on behalf of the United States, to Jack Henry Post, No. 1, of the American Legion, Anchorage, Alaska, the wood-frame building, known as the Telephone and Telegraph Building, located on lots 7 and 8 in block 17, Anchorage townsite, was read twice by its title and referred to the Committee on Public Lands and Surveys; and the letter presented by Mr. HATCH was ordered to be printed in the RECORD, as follows:

THE SECRETARY OF THE INTERIOR,
Washington 25, D. C., September 22, 1943.

HON. HENRY A. WALLACE,
President of the Senate.

MY DEAR MR. VICE PRESIDENT: I transmit herewith a proposed bill "to authorize the

Secretary of the Interior to donate and convey, on behalf of the United States, to the Jack Henry Post, No. 1, of the American Legion, Anchorage, Alaska, the wood-frame building, known as the telephone and telegraph building, located on lots 7 and 8 in block 17, Anchorage townsite."

The building proposed to be donated is one story in height and measures 36' x 46'. It was built by the Alaska Railroad in 1916 at a cost of \$3,826.43 and was used by the Alaska Railroad and by the city of Anchorage as a city office and telephone and telegraph exchange until September 30, 1937, at which time the city and the Alaska Railroad discontinued the use of the building and removed all equipment.

Beginning in October 1937, the Civilian Conservation Corps occupied the building, rent free, as living quarters with the understanding that it would vacate if the site should be required for the construction of a United States post office and court house. When, in December 1938, the site was required for that purpose, the Civilian Conservation Corps requested permission to move the building to nearby land of the Jack Henry Post, No. 1, of the American Legion, which it had rented for a nominal sum. This permission was granted and the building was moved to the land of the Jack Henry Post where the post had provided, without cost to the United States, a concrete basement foundation and plumbing fixtures to facilitate the use of the building.

On August 25, 1942, the Civilian Conservation Corps unit moved out of the building to its camp on Palmer highway. In the meantime, the Jack Henry Post had permitted the demolition of its building on other land so that the land might be used (at a rental of \$1 per year) by the United Service Organizations for the erection of a building.

Accordingly the manager of the Alaska Railroad leased the building to the Jack Henry Post, No. 1, for 5 years, beginning September 1, 1942, at a monthly rental of \$2.50. The post has made improvements to the building which it uses as a meeting and club room for itself and its Women's Auxiliary, and has also made meeting space available to the Boy Scouts without charge. No commercial enterprise is carried on within the building.

In view of the generosity of the Jack Henry Post, No. 1, to the United States, the questionable salvage value of the building, and the small rental income therefrom, I recommend that the proposed bill be enacted.

The Bureau of the Budget has advised me that there would be no objection to the submission of the proposed legislation to the Congress.

Sincerely yours,

HAROLD L. ICKES,
Secretary of the Interior.

ADJUSTMENT OF MAXIMUM PRICES ON MILK

During the delivery of Mr. REED's speech, which appears later in today's proceedings, the following occurred:

Mr. EASTLAND. I ask unanimous consent to introduce a bill on behalf of the junior Senator from Arkansas [Mr. McCLELLAN] and myself, and request that it be referred to the Committee on Agriculture and Forestry.

The PRESIDING OFFICER (Mr. McCLELLAN in the chair). Without objection, the bill will be received and referred as requested by the Senator from Mississippi.

The bill (S. 1418) to provide for the adjustment of maximum prices on milk, and for other purposes, was read twice by its title and referred to the Committee on Agriculture and Forestry.

HOUSE BILLS REFERRED

The following bills were severally read twice by their titles and referred, as indicated:

H. R. 800. An act to provide for the issuance of a flag to the nearest relatives of certain persons who die in service in the land or naval forces of the United States; to the Committee on Military Affairs.

H. R. 1042. An act for the relief of Frank J. Recely and Mary T. Recely;

H. R. 1144. An act for the relief of Fred A. Flanders;

H. R. 2190. An act for the relief of Marguerite R. McElroy;

H. R. 2304. An act for the relief of Harry Tansey; and

H. R. 2459. An act for the relief of the legal guardian of Carl Oplinger, City Hospital of Akron, Ohio, and to Dr. Walter A. Hoyt; to the Committee on Claims.

ISSUANCE OF IDENTIFICATION CARDS TO SENATORS

Mr. McKELLAR submitted a resolution (S. Res. 186), which was ordered to lie on the table, as follows:

Resolved, That the Sergeant at Arms of the Senate is authorized and directed to issue to each Senator an identification card bearing a photograph of such Senator, the signature of such Senator, or a facsimile thereof, and the words "the person whose photograph and signature appear hereon is a Member of the United States Senate." Each such identification card shall be signed by the Sergeant at Arms.

SEC. 2. When any identification card issued under the foregoing section is presented or exhibited by the Senator to whom it was issued, such Senator shall be admitted to any building or other property occupied or used by any department or agency of the Government, and shall be so admitted without regard to any rule, regulation, or requirement of such department or agency relating to the admittance or identification of persons entering such building or other property.

RENUNCIATION OF EXTRATERRITORIAL RIGHTS IN CHINA

Mr. THOMAS of Utah. Mr. President, I ask unanimous consent that an article which I have prepared on the subject of extraterritoriality in China be printed as a Senate document.

The PRESIDING OFFICER. Is there objection to the request of the Senator from Utah? The Chair hears none, and it is so ordered.

Mr. THOMAS of Utah. I also ask unanimous consent, Mr. President, that there be printed in the Appendix of the Record a statement prepared by me concerning the above article.

There being no objection, the statement was ordered to be printed in the Record.

[The statement will appear hereafter in the Appendix.]

NATIONAL WAR FUND—ADDRESS BY THE PRESIDENT

[Mr. BARKLEY asked and obtained leave to have printed in the Record a radio address delivered by the President of the United States on October 5, 1943, in connection with the National War Fund, which appears in the Appendix.]

BEHEADING OF AN AMERICAN FLYER BY THE JAPANESE—COMMENT BY THE PRESIDENT

[Mr. BARKLEY asked and obtained leave to have printed in the Record a newspaper

article dated October 6, 1943, giving an account of the President's comment in a press conference regarding the beheading of an American flyer by the Japanese, which appears in the Appendix.]

ADDRESS BY SENATOR BUTLER ON FOOD SITUATION IN SOUTH AMERICA

[Mr. BUTLER asked and obtained leave to have printed in the Record an address entitled "The Food Situation in South America," delivered by him at the National Food Conference, Chicago, September 16, 1943, which appears in the Appendix.]

THE CATTLE SITUATION—ADDRESS BY C. J. ABBOTT

[Mr. BUTLER asked and obtained leave to have printed in the Record an address entitled "The Cattle Situation," delivered by C. J. Abbott, of Hyannis, Nebr., at the National Food Conference, Chicago, September 16, 1943, which will appear hereafter in the Appendix.]

ADDRESS BY JESSE H. JONES ON POST-WAR PROBLEMS

[Mr. CONNALLY asked and obtained leave to have printed in the Record an address entitled "Post War Problems," delivered by Hon. Jesse H. Jones, Secretary of Commerce, before the New York Board of Trade, September 30, 1943, which appears in the Appendix.]

MANPOWER—ADDRESS BY JAMES P. MITCHELL

[Mr. AUSTIN asked and obtained leave to have printed in the Record an address entitled "Manpower," delivered by James P. Mitchell, Director, Industrial Personnel Division, Army Service Forces, at the War Department Conference of Industry, Labor, and Newspaper Leaders, Washington, D. C., September 28, 1943, which will appear hereafter in the Appendix.]

ADDRESS BY FRANK E. GANNETT AT NATIONAL FOOD CONFERENCE

[Mr. BUSHFIELD asked and obtained leave to have printed in the Record an address delivered by Frank E. Gannett at the National Food Conference, Chicago, Ill., September 16, 1943, which appears in the Appendix.]

FOOD FOR 1944—ADDRESS BY WHEELER McMILLEN

[Mr. BUSHFIELD asked and obtained leave to have printed in the Record an address entitled "Food for 1944," delivered by Wheeler McMillen, editor in chief of the Farm Journal and Farmer's Wife, at the National Food Conference, at Chicago, Ill., on September 16, 1943, which appears in the Appendix.]

WILLIAM C. BULLITT'S CANDIDACY FOR MAYOR—STATEMENT BY HARRISON E. SPANGLER

[Mr. GUFFEY asked and obtained leave to have printed in the Record an article by Thomas P. O'Neil, published in the Philadelphia Record of October 5, 1943, dealing with the statement made by Republican National Committee chairman, Harrison E. Spangler, concerning the candidacy of William C. Bullitt, which appears in the Appendix.]

FREIGHT-RATE LEGISLATION WILL NOT FIX PRICES—EDITORIAL FROM LOUISVILLE COURIER-JOURNAL

[Mr. STEWART asked and obtained leave to have printed in the Record an editorial entitled "Freight Rate Legislation Will Not Fix Prices," published in the Louisville Courier-Journal for September 27, 1943, which appears in the Appendix.]

SYNTHETIC LIQUID FUELS

OCTOBER 6 (legislative day, SEPTEMBER 15), 1943.—Ordered to be printed

Mr. O'MAHONEY, from the Committee on Public Lands and Surveys,
submitted the following

REPORT

[To accompany S. 1243]

The Committee on Public Lands and Surveys, to whom was referred the bill (S. 1243), authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having carefully considered the same, report favorably thereon with the following amendments and with the recommendation that the bill, as amended, do pass.

On page 2, line 2, after the word "products." add the following:

The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

On page 3, line 16, after the word "purchaser" strike out the period and add the following: "through regular commercial channels."

This bill might well be termed a bill to assure the United States a continuous supply of domestically produced motor fuel and aviation gasoline. The military demands for petroleum and its products during the war have been so great that we are now burning up liquid fuel at the rate of approximately 1½ billion barrels of crude oil every year. This tremendous drain upon American supplies has been occasioned by the fact that the United States oil fields have been the only sure and certain source of supply for the armies, the navies, and the air forces of all the United Nations. Even though the recovery of the Mediterranean Sea from Axis control is opening up middle eastern sources of oil, the demand for American supplies is likely to continue at a tremendously high rate because the American air fleets are being constantly augmented. More and larger planes

of longer flying radius are under construction and the demand for these planes will not be appreciably diminished while the war with Japan continues.

The consumption of oil in the United States is now proceeding annually at a rate much greater than the discovery of new supplies. During the years 1940, 1941, and 1942, the additions to the proven oil reserves of the Nation amounted in the aggregate to approximately 1.6 billion barrels of crude oil as compared with additions of 5.4 billion barrels in the preceding 3 years. The rate of discovery has been steadily declining and while your committee is of the opinion that the search for oil in the public-land States can be successfully stimulated it is nevertheless evident that the demand for liquid fuel is likely to continue at such a high rate that the Nation's interest can be conserved only by immediate action to bring about the manufacture of synthetic liquid fuel from the unlimited supplies of coal which this country possesses and from vast deposits of oil shale to be found in several of the public-land States.

There can be no doubt now that aviation will be one of the principal industries toward which the world will turn after the war. The United States now occupies a position of world leadership in this field. Not only because of the genius and skill of its citizens who are engaged in the design and manufacture of airplanes, but because we have had a large supply of crude oil. If, however, the country is to maintain its leadership in the air it must take steps now to guarantee a sure and certain supply of liquid fuel. This can be done by the use of coal, oil shale, and other materials for the manufacture of synthetic liquid fuel. In Germany, Japan, and in England, also, the hydrogenation of coal has been a source of gasoline supply. The process has not been used in the United States largely because of the cost, and industry has not as yet undertaken to demonstrate the possibilities.

The Bureau of Mines, acting under the authorization of a special appropriation, has made experiments in a small plant at the Bureau of Mines station in Pittsburgh, Pa. These experiments, which have been successfully carried out, have proceeded to such a point that it is now desirable to carry them on in a more extensive manner. The Pittsburgh tests were scarcely more than laboratory tests; the next step is to construct and operate demonstration plants.

The committee held hearings during the recess of Congress at Washington, D. C., Pittsburgh, Pa., Salt Lake City, Utah, and Sheridan, Wyo. Opportunity was extended to all branches of industry to discuss the measure. The response, not only from industry but also from public authorities in the coal-bearing States, was little short of enthusiastic. Only one doubt was expressed; namely, that the authority might be used to put the Government in competition with private industry. This was not the intention of the sponsor of the bill, nor of the Department of the Interior, and statements to that effect were made at the hearings. In order to make the matter clear, however, the committee, at the recommendation of the subcommittee which conducted the hearings, has adopted the amendments on pages 2 and 3 of the bill which are set forth in full above, to make certain that there will be no invasion of the domain of private industry and no competition by Government with commercial enterprise.

The report of the Secretary of the Interior is hereinbelow set forth in full and made a part of this report.

THE SECRETARY OF THE INTERIOR,
Washington 25, D. C., August 2, 1943.

HON. CARL A. HATCH,
*Chairman, Committee on Public Lands and Surveys,
United States Senate, Washington, D. C.*

MY DEAR SENATOR HATCH: You have asked my views on the provisions of S. 1243, a bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

I am wholeheartedly in favor of the legislation proposed in the bill. It is high time that the country embarked in earnest upon the program of research and development work necessary to determine the processes and equipment required for the establishment of an industry which can help to supply the continuing needs of the country for liquid fuels which have heretofore been available from the ample but now waning domestic petroleum reserves.

The total demand for liquid fuel in 1941 and 1942 reached about 1.5 billion barrels annually. The rate of discovery of petroleum has decreased sharply since 1937. In the 3 years 1937-39 about 5.4 billion barrels were added to the Nation's proved oil reserves, whereas in the 3 years 1940-42 the increment was only 1.6 billion barrels. In 1942, the new reserves discovered, including extensions and new horizons in old fields, were at a low of 317 million barrels or only about one-fifth of our annual rate of consumption. This failure to find adequate quantities of new oil was not due to lack of prospect drilling, as 3,264 wildcat wells were drilled in 1941 and 3,029 in 1942. The decline in the rate at which new discoveries are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The ominous implications of the progressive effect of this decline upon the peacetime economy of the post-war years are easily foreseen and can be effectively forestalled by timely action. The answer to the problem clearly lies in the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

It is apparent that this country can no longer delay in embarking upon a synthetic liquid fuel program. Our study of petroleum reserves and the rate of their depletion indicates clearly that unless we take action, the end of the age of abundant oil is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, the Department of the Interior has been aware of these trends and has initiated the study of means which may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

However, the time has come when we must get out of the test-tube stage into actual production. Past experiments have given us the scientific knowledge of the basic processes involved but the way must be blazed for American industry to enter this synthetic fuel field, which inevitably will be one of the major industrial developments of the near future.

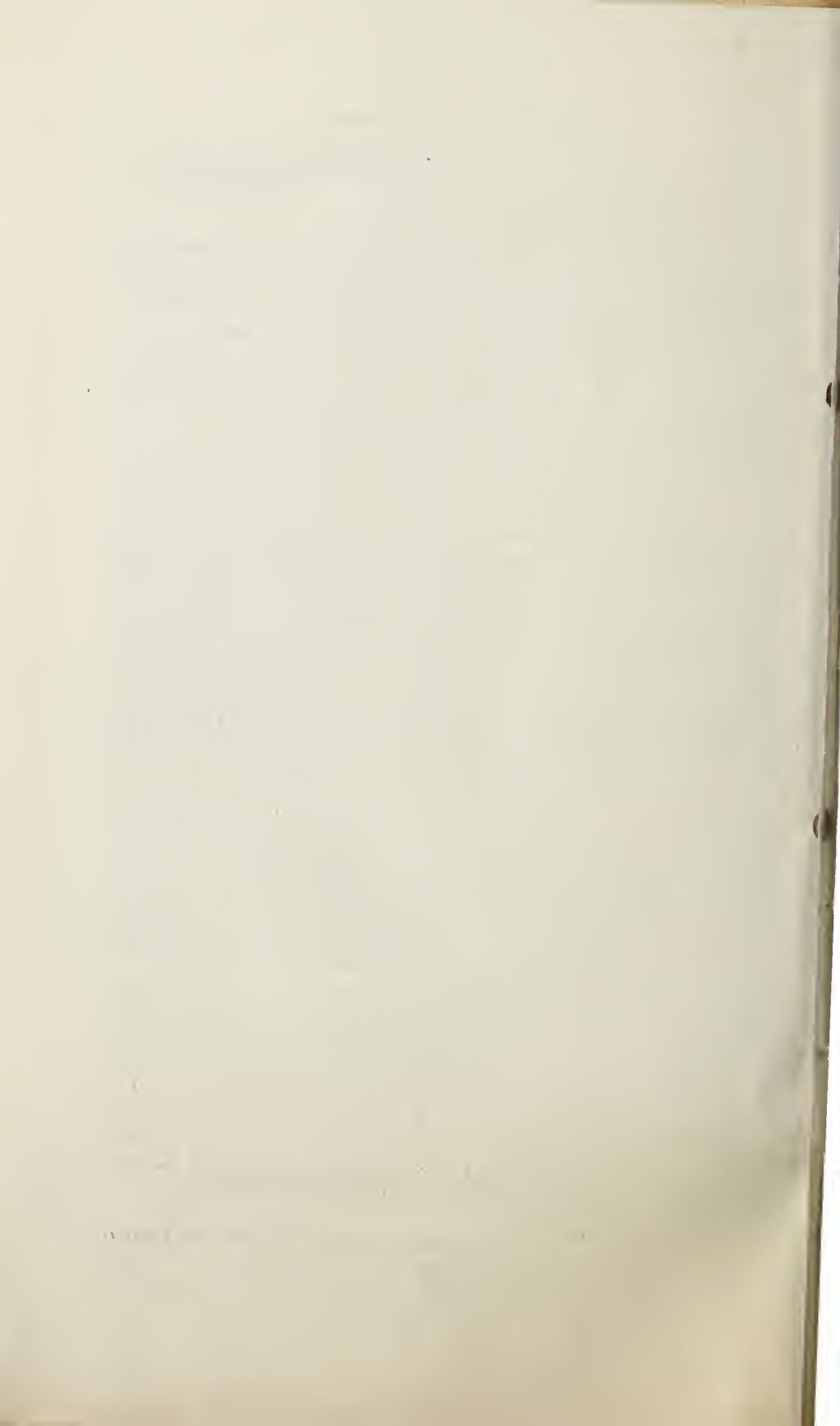
It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly. Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up the work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that private enterprise can take up the task of providing synthetic fuels on the scale necessary to safeguard the Nation's future.

The Department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

Sincerely yours,

HAROLD L. ICKES, *Secretary of the Interior.*

○



S. 1243

[Report No. 445]

IN THE SENATE OF THE UNITED STATES

JUNE 18 (legislative day, MAY 24), 1943

MR. O'MAHONEY introduced the following bill; which was read twice and referred to the Committee on Public Lands and Surveys

OCTOBER 6 (legislative day, SEPTEMBER 15), 1943

Reported by Mr. O'MAHONEY, with amendments

[Insert the part printed in *italic*]

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

- 1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That the Secretary of the Interior, acting through the
4 Bureau of Mines, within the limits of critical materials
5 available, is authorized to construct, maintain, and operate
6 one or more demonstration plants to produce synthetic liquid
7 fuels from coal and other substances with all facilities and
8 accessories for the manufacture, purification, storage, and

1 distribution of the products. *The plants shall be of the mini-*
2 *mum size which will allow the Government to furnish industry*
3 *the necessary cost and engineering data for the development*
4 *of a synthetic liquid fuel industry and of such size that the*
5 *combined product of all the plants constructed in accordance*
6 *with this Act will not constitute a commercially significant*
7 *amount of the total national commercial sale and distribution*
8 *of petroleum and petroleum products.*

9 SEC. 2. In order to carry out the purpose of this Act,
10 the Secretary of the Interior is authorized—

11 (a) to conduct laboratory research and develop-
12 ment work necessary to determine the best demonstra-
13 tion plant designs and conditions of operation;

14 (b) to acquire, by purchase, lease for a term of
15 years or less, donation, or otherwise, land and any
16 interest in land, including easements and leasehold in-
17 terests; options on real or personal property; plants
18 and their facilities; secret processes, technical data,
19 inventions, patent applications, patents, irrevocable non-
20 exclusive licenses, and other rights and licenses under
21 patents granted by this or any other nation; to assume
22 the obligation to pay rentals in advance on property so
23 acquired, and to pay damages arising out of the use of
24 any such property;

25 (c) to engage, by contract or otherwise, engineers,

1 architects, and any private industrial organization he
2 deems suitable, to do all or any part of the work of
3 designing, constructing, or operating the plants, the
4 operation to be under his supervision, and through
5 leases or otherwise as he believes advisable;

6 (d) to cooperate with any other Federal or State
7 department, agency, or instrumentality, and with any
8 private person, firm, or corporation, in effectuating the
9 purposes of this Act.

10 Sections 321 and 322 of the Act of June 30, 1932 (47
11 Stat. 412), as amended, shall not apply to any leases under
12 this section; and such leases may be made for a term of
13 years notwithstanding Revised Statutes, section 3679, as
14 amended, or any other provision of law.

15 SEC. 3. The Secretary of the Interior is authorized to
16 sell the products of the plants at not more than actual cost,
17 including amortization of capital expenses, as determined by
18 him, to any department, agency, or instrumentality of the
19 Federal or any State government, but priority shall be given
20 to orders placed by the War or Navy Departments. Any
21 remaining products may be sold at going prices to any
22 purchaser *through regular commercial channels*. The Secre-
23 tary of the Interior, in his discretion, shall also have authority
24 to dispose of any lands or other real or personal property
25 acquired, but in his opinion no longer useful, for the purposes

1 of this Act, and to grant, on such terms as he may consider
2 appropriate, licenses under patent rights acquired under this
3 Act.

4 SEC. 4. All moneys received under this Act for products
5 of the plants and royalties shall be paid into the Treasury
6 as miscellaneous receipts. The Secretary of the Interior shall
7 render to Congress on or before the first day of January of
8 each year a report of all operations under this Act.

9 SEC. 5. The Secretary of the Interior may issue rules
10 and regulations to effectuate the purposes of this Act. The
11 authority and duties of the Secretary of the Interior under
12 this Act shall be exercised through the Bureau of Mines of
13 the Department of the Interior.

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

By Mr. O'MAHONEY

JUNE 18 (legislative day, MAY 24), 1943
Read twice and referred to the Committee on Public
Lands and Surveys

OCTOBER 6 (legislative day, SEPTEMBER 15), 1943
Reported with amendments

The VICE PRESIDENT. Without objection, Senate bill 1345 will be indefinitely postponed.

Mr. HATCH. Mr. President, a parliamentary inquiry.

The VICE PRESIDENT. The Senator will state it.

Mr. HATCH. I have just arrived in the Chamber. I am wondering what happened to Calendar No. 400, Senate bill 1272.

The VICE PRESIDENT. The call of the calendar was started with Calendar No. 416.

Mr. HATCH. Senate 1272 is an important bill.

Mr. McKELLAR. Mr. President, will the Senator yield?

Mr. HATCH. I yield.

Mr. McKELLAR. The next two bills on the calendar are very important to the Post Office Department. I wonder if the Senator would be willing to postpone his request with respect to Calendar No. 400 until after those bills are called? I am obliged to leave the Chamber.

Mr. HATCH. Very well.

The VICE PRESIDENT. The clerk will state the next business on the calendar.

INTERCHANGEABLE USE OF POST-OFFICE CLERKS AND CITY LETTER CARRIERS

The bill (S. 970) authorizing the Postmaster General to use post-office clerks and city letter carriers interchangeably was announced as next in order.

Mr. McNARY. Mr. President, I am not familiar with the measure. It is not a House bill. It is a bill proposed by the chairman of the Senate Committee on Post Offices and Post Roads [Mr. McKELLAR].

Mr. McKELLAR. The Senator is correct. It is very strongly recommended by the Post Office Department that post-office clerks and city letter carriers be used interchangeably. I will read a very short statement from a letter addressed to the President of the Senate by the Postmaster General:

While the country is in a state of war, it is deemed highly desirable that the Post Office Department have authority to interchange personnel to meet the particular necessities of the occasion.

It was the unanimous opinion of the committee that at a time such as the present, when we are at war, the recommendation of the Post Office Department should be followed. That was the purpose of the bill, and the only purpose.

The VICE PRESIDENT. Is there objection to the present consideration of the bill?

There being no objection, the bill (S. 970) authorizing the Postmaster General to use post-office clerks and city letter carriers interchangeably was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted, etc., That while the United States is at war and for 6 months thereafter, the Postmaster General may, when the interest of the Service requires, temporarily assign any post-office clerk to the duties of city delivery carrier or any such carrier to the duties of such clerk and in an emergency may assign any post-office employee to the duties of a railway postal clerk or any railway postal

clerk to the duties of a post-office employee without change of pay-roll status, the compensation of any temporary assigned employee to be paid from the appropriation made for the work to which he is regularly assigned.

APPLICATION OF RECLASSIFICATION ACT TO CUSTODIAL EMPLOYEES IN THE POSTAL SERVICE

The bill (H. R. 2250) to extend the provisions of the Reclassification Act of February 28, 1925, to include custodial employees in the Postal Service, was considered, ordered to a third reading, read the third time, and passed.

Mr. McKELLAR. I thank the Senator from New Mexico very much.

Mr. HATCH. Mr. President, I merely wish to say at this time that it was my intention to ask unanimous consent that the Senate proceed to the consideration of Calendar No. 400, Senate bill 1272. However, it has been suggested that I wait until the call of the calendar is completed, which I am glad to do, because the bill is one on which I think there should be a record vote. As soon as the calendar is completed I shall ask unanimous consent to recur to order No. 400, Senate bill 1272, and request a ye-and-nay vote.

Mr. LANGER. Mr. President, I wish later to make the same request with reference to Calendar No. 349, Senate bill 878, which is a bill to amend the act entitled "An act to amend further the Civil Service Retirement Act approved May 29, 1930, as amended, approved January 24, 1942."

The VICE PRESIDENT. The clerk will state the next measure on the calendar.

APPLICATION OF EXCESS-PROFITS TAX TO PRODUCTION BONUS PAYMENTS

The Senate proceeded to consider the bill (H. R. 2838) relating to the application of the excess-profits tax to certain production bonus payments.

Mr. GEORGE. Mr. President, House bill 2888 is designed to amend section 735 (c) and section 711 (a) (1) (I) and (a) (2) (K) of the Internal Revenue Code insofar as these sections relate to nontaxable bonus income. The bill in substance provides that the income from bonus payments made by a Government agency on account of the production in excess of a specified quota of mineral products recovered from mine tailings shall be excluded from the excess-profits tax, whether or not the producer had an economic interest in the mineral property.

Section 4 of the bill provides that the amendments shall be applicable to taxable years beginning after December 31, 1940, which is the effective date of the provisions of the present law relating to nontaxable bonus income. The effective date of the provisions of the present law relating to nontaxable income from excess output of mines and timber blocks is not intended to be changed by this bill. The latter provisions will continue to be applicable only to taxable years beginning after December 31, 1941.

The bill is highly recommended by the War Production Board. The Treasury

offers no objection to it. It has been unanimously reported by the Senate Finance Committee without amendment. But there is some possibility that section 4 of the bill might lead to some confusion. I therefore offer an amendment to the bill as reported by the committee, to strike out section 4 of the bill and insert a new section 4, which relates only to the effective date of the amendment. It is intended to prevent confusion in that respect.

The VICE PRESIDENT. The amendment will be stated for the information of the Senate.

The CHIEF CLERK. On page 3, after line 10, it is proposed to strike out section 4 of the bill and insert in lieu thereof the following:

SEC. 4. The amendments made by this act shall be effective as if they were a part of section 209 of the Revenue Act of 1942 on the date of its enactment.

The VICE PRESIDENT. The question is on agreeing to the amendment offered by the Senator from Georgia [Mr. GEORGE].

Mr. McNARY. Mr. President, what is the number of the bill?

Mr. GEORGE. It is House bill 2888, Calendar No. 424. It passed the House unanimously and was reported by the Senate Finance Committee without amendment. But in order to avoid any confusion as to the effective date of the amendment the Treasury believes that section 4 should be eliminated, and that a new section 4 should be inserted in lieu thereof.

Mr. McNARY. Mr. President, I have no objection to the explanation of the bill, but I am at a loss to know what happened after we reached Calendar No. 416. As I understand, Calendar No. 418, Senate bill 1345, was passed. Some amendments were included in Calendar No. 423, House bill 3208.

The VICE PRESIDENT. Calendar No. 418, Senate bill 1345, was indefinitely postponed when the corresponding House bill was passed.

Mr. McNARY. Was Calendar No. 421, Senate bill 970, passed?

The VICE PRESIDENT. Calendar No. 421, Senate bill 970; Calendar No. 422, House bill 2250; and Calendar No. 423, House bill 3208, were all passed, and the Senate is now considering Calendar No. 424, House bill 2888.

Mr. McNARY. That is the bill to which reference is being made by the able Senator from Georgia?

Mr. GEORGE. That is correct.

Mr. McNARY. To that bill I have no objection.

The VICE PRESIDENT. The question is on agreeing to the amendment offered by the Senator from Georgia.

The amendment was agreed to.

The amendment was ordered to be engrossed, and the bill to be read a third time.

The bill was read the third time and passed.

DEMONSTRATION PLANTS TO PRODUCE SYNTHETIC LIQUID FUELS

Mr. O'MAHONEY. Mr. President, I ask unanimous consent to proceed to the consideration of calendar No. 451, Senate

bill 1243. I make the request, after having consulted the leaders on both sides of the Chamber, because it will be necessary for me to leave the Chamber within a short time.

The VICE PRESIDENT. Is there objection to the request of the Senator from Wyoming?

Mr. McNARY. Mr. President, we always object to a change in the program unless it is based on some very strong reasons. I understand that the Senator desires to leave the city within a few minutes.

Mr. O'MAHONEY. At 2 o'clock; yes.

Mr. McNARY. Under those circumstances I have no objection.

The PRESIDING OFFICER (Mr. McFARLAND in the chair). The clerk will state the bill by its title for the information of the Senate.

The CHIEF CLERK. A bill (S. 1343) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

The PRESIDING OFFICER. Is there objection to the present consideration of the bill?

There being no objection, the Senate proceeded to consider the bill, which had been reported from the Committee on Public Lands and Surveys with amendments: On page 2, after the word "products", to insert "The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid-fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products"; and on page 3, line 22, after the word "purchaser", to insert "through regular commercial channels", so as to make the bill read:

Be it enacted, etc., That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid-fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

SEC. 2. In order to carry out the purpose of this act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, donation, or otherwise, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their

facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this act.

Sections 321 and 322 of the act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this act, and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this act.

SEC. 4. All moneys received under this act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this act. The authority and duties of the Secretary of the Interior under this act shall be exercised through the Bureau of Mines of the Department of the Interior.

There being no objection, the Senate proceeded to consider the bill.

Mr. McNARY. Mr. President, may we have a statement concerning the objectives of the bill?

Mr. O'MAHONEY. Mr. President, the bill was introduced for the purpose of utilizing or creating the opportunity to utilize the natural resources of the United States in coal, oil shale, and other substances, for the purpose of demonstrating that synthetic liquid fuel can be manufactured. The oil resources of the United States are being rapidly depleted. The depletion is likely to continue without regard to the exigencies of the war because the consumption of liquid fuel in this country has been increasing by leaps and bounds. During the course of the hearings upon this bill, the distinguished Senator from South Dakota [Mr. GURNEY] asked the Bureau of Mines to submit statistics upon the domestic consumption of oil in the United States. The figures which were furnished show that in 1931 the total consumption of oil in the United States amounted to 903,200,000 barrels, and that this amount

had increased by 1939—in 8 years—to 1,231,000,000-barrels. So that even before the beginning of the war, before we were making the tremendous supplies out of our resources which we are now making, the use of oil for domestic industry had tremendously increased.

The rate of discovery of oil in the United States has been rapidly decreasing. How significant this is may be judged when I say that the evidence gathered by a joint subcommittee of the Public Lands Committee of the Senate and of the Committee on Mines and Mining of the House of Representatives, headed by Representative RANDOLPH, of West Virginia, developed that one well has been drilled for every 3 square miles of territory in the United States; but in the world abroad, one well to only 500 square miles of territory. The largest area of unexplored lands on which oil may be found is in Russia; so that the future, in a very real sense, belongs to Russia so far as proved petroleum is concerned.

On the other hand, the coal deposits of the United States are so tremendous as to be practically inexhaustible. The testimony before the joint hearing was to the effect that, although we are consuming a billion and a half barrels of crude oil a year, we could make that amount of oil by the hydrogenation process from coal and still have enough to last a thousand years at that rate.

Mr. GUFFEY. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield to the Senator from Pennsylvania.

Mr. GUFFEY. How large an investment will it require, to produce that amount of oil?

Mr. O'MAHONEY. The investment will have to be made by private industry, and it would be a very large investment, no doubt.

Mr. HATCH. Mr. President, will the Senator yield at that point?

Mr. O'MAHONEY. I yield to the Senator from New Mexico.

Mr. HATCH. The Senator said the investment would be made by private industry. There was some question raised, as I recall, that the Government was going into competition with oil and synthetic fuels.

Mr. O'MAHONEY. That was not the intention of the sponsor of the bill, and it was not the intention of the Bureau of Mines. The committee, as its distinguished chairman well knows, has adopted a specific amendment to make clear that there will be no Government competition.

Mr. HATCH. The reason I asked the question, Mr. President, was in order that the Senator might make that explanation. The amendment does make that entirely clear, and I thought it should be made clear.

Mr. O'MAHONEY. The evidence before us is that industry is not making the investment that is necessary to do the pioneering work. The purpose of this bill is to authorize the Bureau of Mines to undertake the pioneering work, so that the tremendous resources of the Government and the scientific methods of hydrogenation may be made available to private industry.

Mr. GURNEY. Mr. President—

Mr. O'MAHONEY. I yield to the Senator from South Dakota.

Mr. GURNEY. I cannot let this bill pass without making a statement that I am in full accord with the Senator from Wyoming that the passage of this bill is very necessary. It would be necessary even though we were not at war. Our motor-fuel materials are so short now that we must do everything possible to enable industry, in the future, to furnish us with motor fuel from other materials than those we are now using. The members of the subcommittee during the summer held hearings for some 3 weeks. At those hearings large and small petroleum companies testified, and all of them were in agreement that this is a Government function, and they gave hearty approval to the passage of this bill. I hope it will be passed by unanimous consent not only by the Senate but by the other House. I believe we can fully recommend to the House that they concur in our action.

Mr. McNARY. Mr. President—

Mr. O'MAHONEY. I yield to the Senator from Oregon.

Mr. McNARY. Mr. President, from a very hasty reading of the bill I do not observe any appropriation or authorization for an appropriation. Let me ask the Senator in charge of the bill where will the money come from?

Mr. O'MAHONEY. There will be no money without an appropriation, of course, as the Senator well knows. It is the thought of the Public Lands Committee that the determination as to the amount of money which should be expended should be made by the respective Appropriations Committees of the two Houses. It was estimated by the Bureau of Mines that if demonstration plants were built to handle oil, shale and coal, several plants, an expenditure of twenty or thirty million dollars might be involved; but the committee did not recommend such an expenditure without having a full report from the Bureau of the Budget and a full examination by the Committee on Appropriations.

Mr. McNARY. It is very unusual to propose a bill of this kind without authorizing an appropriation or actually making an appropriation out of the Treasury.

Mr. O'MAHONEY. I would not want the bill to carry an appropriation, but, if the Senator desires, I should be very happy to offer an amendment providing that not to exceed \$30,000,000 shall be authorized.

Mr. McNARY. The Senator from Oregon is not referring to what should be done with the bill, but from a good many years of experience and some observation, I do not recall a bill similar to this having been introduced or reported without an authorization or an appropriation. It evidently contemplates an appropriation.

Mr. O'MAHONEY. It does not carry an appropriation, it merely authorizes the expenditure.

Mr. McNARY. It does not authorize anything as I understand, it does not even authorize an appropriation.

The PRESIDING OFFICER. The time of the Senator from Wyoming has expired. Does the Senator from Oregon desire to be recognized in his own time?

Mr. McNARY. I do not want to take any other Senator's time, and probably I shall not object to the bill. I shall take my own time.

Mr. President, it is the nature of the legislation that attracts me more than the purpose that may be in the mind of the Senator who is in charge of the bill. I have no objection to the proposition, but ordinarily, when such a bill comes here authorizing certain things to be done by agencies of the Government, it also contains an estimate or authorization for the amount that must be appropriated, after meeting with the approval of the Committee on Appropriations.

From a hasty reading of the bill, it seems to set forth some very desirable purposes to be undertaken on the part of the Secretary of the Interior through the Bureau of Mines, but, as I read it, there is nothing in the bill that states that it is based upon an ultimate appropriation by the Congress.

Mr. O'MAHONEY. I shall be very happy to repair that defect, although I am frank to say to the Senator that I do not think it actually exists. On page 1 of the bill, the language is as follows:

That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products.

Mr. McNARY. I read that a moment ago. I am speaking on the bill in my own time. It is a nice statement of what the ambition of the Secretary of the Interior through the agency of the Bureau of Mines may be, but it does not specify, as it should, that there is hereby authorized to be appropriated the sum of money which the members of the committee must have had in mind when they reported the bill. It is merely a recital of ideas in the mind of someone without any thought of what the cost will be. Now the Senator tells me very frankly that the bill probably will cost \$30,000,000. From a reading of the bill I do not know whether it is going to cost 30 cents or \$30,000,000. A measure of this kind ought to give some idea what the cost will be before it is brought to the attention of the Senate for consideration.

Mr. O'MAHONEY. In order to meet the suggestion of the Senator from Oregon, I move that, on page 2, line 1, after the period there be inserted the following sentence:

There is hereby authorized to be appropriated not to exceed \$30,000,000 for the purposes of this act.

Mr. McNARY. That puts it in better form. I am not advocating \$30,000,000 or saying that is the proper sum or whether it is sufficient, but the amendment would put the bill in a position upon which we may intelligently operate.

Mr. JOHNSON of Colorado. Mr. President, I did not wish to take the Senator from Wyoming off the floor. I understood his time had expired. However, I have one question I wish to ask him. First, I want to say that I am in complete accord with the purposes of the bill as I understand them and with the statement made by the Senator from Wyoming and the Senator from South Dakota [Mr. GURNEY].

On page 3 of the bill, at the bottom of the page, I find this language:

The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired—

And so forth. The question I wish to submit to the Senator from Wyoming is whether or not that gives the Secretary of the Interior any authority over public lands containing deposits of oil, shale, and coal.

Mr. O'MAHONEY. I think not, because that refers to properties which may be acquired. Of course, public lands are not lands which would fall within that definition.

Mr. JOHNSON of Colorado. I do not like the language of the Senator's reply when he says, "I think not." I want him to say something more positive than "I think not."

Mr. O'MAHONEY. I shall be very glad to accommodate the Senator and say that the language to which he refers does not cover the public lands.

Mr. DANAHER. Mr. President, will the Senator yield?

Mr. O'MAHONEY. If I have the floor.

The PRESIDING OFFICER. The time of the Senator from Wyoming has expired. Does the Senator from Connecticut desire recognition in his own time?

Mr. DANAHER. Yes.

The PRESIDING OFFICER. The Senator from Connecticut is recognized.

Mr. DANAHER. On page 2, line 14, I notice that the Secretary of the Interior would be authorized "to acquire, by purchase, lease for a term of years or less, donation, or otherwise, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses," and the like. What does the Senator understand the words "or otherwise" to mean? Would they authorize the Secretary to acquire these various items of property other than through the means specified?

Mr. O'MAHONEY. I assume that phrase would include condemnation.

Mr. DANAHER. That was exactly what I had in mind. If the Senator from Wyoming construes the term "or otherwise" to mean by condemnation, it follows that very considerable objection would lie to the bill. We have already had one instance, within the year, of the seizure and alleged condemnation of more than 50,000 patents by the Alien Property Custodian, who, in turn, has made them available to American indus-

try, without redress or compensation, and quite contrary to the theory of trusteeship which obtained during the last war. If it should be in the mind of anyone that the Secretary of the Interior was to be given the power to condemn patents, I submit that a very fundamental objection would lie to the bill. There are at least 10 or 12 private plants, I am informed, rendering experimental service to the country at the moment.

Mr. O'MAHONEY. Will the Senator yield?

Mr. DANAHER. I yield.

Mr. O'MAHONEY. I should be very glad to strike out the words "or otherwise." There was no intention on the part of the committee to enter into the domain of wholesale condemnation, and I think that the remarks of the Senator are very appropriate. I shall be very glad to move to amend the bill in that respect.

Mr. DANAHER. Mr. President, to the end that the record may speak, I move, on line 15, page 2, to strike out the words "or otherwise."

The PRESIDING OFFICER. There is already pending an amendment offered by the Senator from Wyoming.

Mr. JOHNSON of Colorado. Will the Senator from Connecticut yield?

Mr. DANAHER. I yield.

Mr. JOHNSON of Colorado. I shall be very glad to have the words "or otherwise" stricken from the bill, because I read them in connection with my inquiry of a moment ago, brought out by the language I find at the bottom of page 3. I do not want to see the Secretary of the Interior acquire, under the term "or otherwise" in the proposed legislation, public lands and then have the right to dispose of them. So I am very glad that the words "or otherwise" are to be stricken from the bill.

The PRESIDING OFFICER. The question is on agreeing to the amendment of the Senator from Wyoming, which will be stated.

The CHIEF CLERK. On page 2, line 1, after the word "products" and the period it is proposed to insert the following: "There is hereby authorized to be appropriated not to exceed \$30,000,000 for the purposes of this act."

The PRESIDING OFFICER. The question is on agreeing to the amendment.

The amendment was agreed to.

Mr. DANAHER. Mr. President, I now move on page 2, line 15, to strike out the words "or otherwise".

The PRESIDING OFFICER. The clerk will state the amendment.

The CHIEF CLERK. On page 2, line 15, after the word "donation" and the comma, it is proposed to strike out "or otherwise" and the comma.

Mr. O'MAHONEY. Mr. President, I ask the Senator whether he will not modify his amendment so as to insert the word "or" before the word "donation".

Mr. DANAHER. Yes.

The PRESIDING OFFICER. The question is on agreeing to the amendment of the Senator from Connecticut as modified.

The amendment as modified was agreed to.

Mr. DANAHER. Mr. President, on page 3 we find another interesting feature of the bill, in lines 10 to 14, inclusive, where it is provided:

Sections 321 and 322 of the act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

After the words "term of" in line 12 I move to insert "not to exceed five".

Mr. O'MAHONEY. I accept the amendment.

The PRESIDING OFFICER. The amendment will be stated.

The CHIEF CLERK. On page 3, line 12, after the words "term of", it is proposed to insert "not to exceed five".

The amendment was agreed to.

Mr. DANAHER. Mr. President, I want the RECORD to show that on its face the proposed legislation purports to be permanent legislation, and to grant authorization to make a lease irrespective of the limitations of law. Obviously, any lease could run 99 years, or 199 years, for that matter. I wanted the RECORD to show my reason for the interpolation to which the Senate has just agreed.

Mr. President, further, there seems to be very substantial lack of understanding among the various Senators present as to the ultimate impact of the bill. A reading of the report of the committee fails to illuminate adequately the doubts I personally have. I notice among other things that in the letter of the Secretary of the Interior he states:

The department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

In other words, we do not have adequate data, it seems to me, upon which to base our consideration of this measure. In view of the fact that this letter is dated August 2, 1943, and has not been supplemented as of today, late in October, I think no pressing need exists which would justify our immediate consideration of the bill, and that we can just as properly dispose of it 72 hours from now as at this particular time. I therefore respectively ask that the bill go over.

Mr. THOMAS of Utah. Mr. President, I trust that the Senator from Connecticut will withhold his objection to the present consideration of the bill. The bill comes before the Senate in a straightforward way, and after a committee hearing and long consideration. Ten years ago I was given my first task in the Senate, to act as chairman of a subcommittee of the Committee on Mines and Mining to hold hearings on a measure which would bring about the elimination of waste of our natural resources, particularly with respect to oil, and when we realized that in the last 10 years we have not moved forward toward any act of conservation to take care of the oil itself, and that we have neglected exactly what the pending bill proposes to accomplish, we must conclude that it

would be wrong for the Senate to put off, even for 72 hours, the beginning of this great work. Time is of the essence.

The Bureau of Mines have done enough to convince them that all they have planned is perfectly feasible, but they have not done it on a large scale. Over 20 years ago, there was inaugurated an investigation by the Bureau of Mines at my university, looking to the extraction of fuel oil from shale, of which there are literally mountains. We turn to the Bureau of Mines for the ultimate conservation of other resources which we are using.

I trust the Senator will withdraw his objection, and that the Senator from Wyoming may proceed with his bill.

Mr. HATCH. Mr. President, I desire to join the Senator from Utah in the request which he has made. I do not need to call the attention of the Senator from Connecticut to the fact that today oil is perhaps the most precious commodity there is in the world. The supplies we have in the United States are being rapidly diminished by the war effort. How long that will continue none of us knows. We do know that the load is increasing constantly. I for one am desperately anxious that this country do everything within its power at least to ascertain and know about the available supplies of petroleum from whatever source they may come, coal, shale or from wells sunk in the ground.

As the Senator from Utah has said, the bill does not represent anything new. I may call the attention of the Senator from Connecticut to a condition which existed in the last war when this country was absolutely dependent upon foreign imports for potash. The Senator knows the history of potash in this country during the last war. As the result of legislation almost identical with the proposed legislation, introduced by the late Senator from Texas [Mr. Sheppard]—

The PRESIDING OFFICER. The time of the Senator from Connecticut has expired.

Mr. HATCH. Mr. President, may I speak in my own time?

The PRESIDING OFFICER. The Senator from New Mexico is recognized.

Mr. HATCH. I shall take but a moment or so. Explorations were carried on by representatives of the United States in connection with private industry in my State. Potash was developed in this country until today we are producing not only sufficient for our use in the United States, but we are even exporting some to our allies who need it desperately.

Mr. President, I do not believe passage of the bill should be delayed. I hope the Senator from Connecticut will withdraw his objection.

Mr. JOHNSON of Colorado. Mr. President, will the Senator yield?

Mr. HATCH. I yield.

Mr. JOHNSON of Colorado. I desire to join the Senator from Utah [Mr. THOMAS] and the Senator from New Mexico [Mr. HATCH] in urging the Senator from Connecticut not to object to the passage of the bill at this time. As the other Senators have so well stated, the bill deals with a matter of grave and

immediate importance. I sincerely hope the Senator from Connecticut will not object to the passage of the bill.

Mr. LANGER. Mr. President, will the Senator from New Mexico yield to me?

Mr. HATCH. I yield.

Mr. LANGER. I desire to join the Senator from Utah [Mr. THOMAS], the Senator from New Mexico [Mr. HATCH], and the Senator from Colorado [Mr. JOHNSON] in the request they have made of the Senator from Connecticut. For over 30 years the University of North Dakota, with the help of the Bureau of Mines and large appropriations from the State of North Dakota, has conducted experimentation with the coal of North Dakota. There are in North Dakota 600,000,000,000 tons of lignite coal, and something should have been done about it many years ago.

The report of the committee on the bill now pending is unanimous. A thorough investigation of the subject has been made. Hearings have been held all over the United States. I hope the Senator from Connecticut will withdraw his objection.

Mr. CONNALLY. Mr. President, in my own time I wish to ask the Senator from Wyoming [Mr. O'MAHONEY] a question. It may not be exactly in point, but in the hearings, in the consideration of his bill, was any testimony adduced with respect to the shortage or prospective shortage of gasoline for war and civilian purposes? Let me predicate my question on this statement: Some days ago I was in a meeting with the War Advisory Board for Oil, which advised with the Secretary of the Interior. The Secretary of the Interior was present, and his oil administrator was present, and a great number of the representatives of the oil industry were present. They there asserted—and I think this to be of general interest because of gasoline rationing, that at the present moment, when from the available supplies of gasoline the demands and the needs of the Army and the Navy are subtracted, there is left remaining for civilian use only 60 percent of what had been used normally by the civilian population in time of peace, and that with the increased demands on the part of the Army and Navy, which they anticipated at an early date, the 60 percent would be reduced.

I think the country should know that, because there is widespread clamor against any restriction in the use of gasoline. That was the view taken not only by the responsible agencies of the Government but by representatives of the independents and representatives of the major companies, and as I recall—and the Senator from New Mexico [Mr. HATCH] was present—there was no dissent from that view.

Mr. O'MAHONEY. Mr. President, the Senator from Texas is quite correct. The facts are clear. We are using oil much more rapidly than we are discovering oil, and our reserves are being steadily depleted. There can be no question that if we were to continue to take a billion and a half barrels of petroleum out of the reserves each year, as we are now doing, the reserves would not last for 20 years. Of course it would not

be possible to take a billion and a half barrels out of the reserves annually, and unless we supplement that supply of liquid fuel by some such process as is authorized by the bill, it will be impossible for the United States to use gasoline motors as we have been using them, and we will not be able to maintain our leadership in aviation.

Mr. CONNALLY. Mr. President, I thank the Senator for his statement about permanent reserves, but I am talking about the immediate current available supplies of gasoline. These authorities said that there was now available not more than 60 percent of what had been used in peacetime by the civilian population, and that by reason of the demands of the Army and Navy, the 60 percent would have to be reduced. It seems to me that is an answer to many persons who are demanding an unlimited use of gasoline and oil.

Mr. HATCH. Mr. President, the Senator from Texas is exactly correct in what he has said. I was present at the meeting, and there was not any dissent from what has just been reported by the Senator from Texas.

Regarding the critical situation with which we are now confronted, I happen to have before me the current issue, date October 15, of the United States News, giving a news account of the situation as to oil. I wish to read one paragraph from the account which stresses the point we are making as to the vital necessity for us to ascertain in this country just what our oil resources are. The article had been discussing the question of importing oil from other countries, and it says:

The United States load will increase in the months ahead no matter how successful attempts are to take more oil from other areas. Domestic crude output is slated to rise to 4,321,000 barrels a day by April 1944, to 4,400,000 by January 1945. No end to the increase is in sight, and they all go to the military. This continuous drain leads to the question of reserves and the possibility that after the war the United States must depend on other nations for fuel oil.

That, Mr. President, is a contingency I wish to avoid. I want experiments to be conducted now.

The PRESIDING OFFICER. Does the Senator from Connecticut withdraw his objection to the present consideration of the bill?

Mr. DANAHER. No, Mr. President.

The PRESIDING OFFICER. Objection is heard, and the bill will be passed over. The clerk will state the next bill on the Calendar.

ARKANSAS-MISSISSIPPI BRIDGE COMMISSION

The bill (S. 1255) to revive and reenact the act entitled "An act creating the Arkansas-Mississippi Bridge Commission" was announced as next in order.

Mr. DANAHER. Mr. President, my time had expired on the so-called O'Mahoney bill, and I therefore wish to take a few minutes on the pending bill to make reply to statements made by several Senators. In the first place let it be noted that the Secretary of the Interior in his letter to the committee said:

It is high time that the country—

Meaning, of course, the Government—embarked in earnest upon the program of research and development work.

We find the same theme in the committee's report submitted by the Senator from Utah [Mr. THOMAS] with reference to the bill which next will be the order of business. I quote from the report:

The committee takes the position that it is the function of the Congress to make available money to the States for financial assistance in supporting their public schools.

At what point, Mr. President, does the function of government stop? Is it the function of government to provide explorations and investigation of coal, oil, shale, and possible well diggings for oil? Is it the belief of any Senator who has argued here in the last 10 minutes that if this bill goes over until Friday so we may have a chance to look into it that every bus in Washington is going to stop?

Anyone listening to the discussion here as to what will happen because of the shortage of oil would think that to hold up the bill, which was introduced on June 18, and comes to the Senate only today, when its sponsors could have moved at any time in the interim to have it taken up, would be highly dangerous. However, that is mere nonsense. We are not obstructing the war effort. We are not obstructing any development of oil. What we are asked to do is to say that it will be the function of the Government of the United States continually to drain the Treasury of the taxpayers' money, in order to perform functions which always hitherto have been performed by private industry. If there is an oil well anywhere in the United States that is any good, private capital will exploit it, as we all know. If there is a coal-oil development anywhere, capable of profitably yielding coal oil and petroleum products, and ultimately gasoline, private capital will develop it.

Mr. CONNALLY. Mr. President, will the Senator yield?

Mr. DANAHER. I yield.

Mr. CONNALLY. At the meeting dealing with coal oil mentioned a short time ago representatives of the Bureau of Mines and others were present. They stated that oil could be produced from coal at about a 30-percent increase in the prices we now are paying for gasoline, and that in the United States we have enough coal in reserve to last us for 3,000 years. I hope that is true. I simply suggest that to the Senator. I suppose the cheaper coals—lignite and others—could be used, but no doubt their use would increase the cost, and probably they would produce an inferior grade of oil.

It was also shown that some of our belligerents in the war are now obtaining gasoline from the hydrogenation of coal and other products.

Mr. DANAHER. Mr. President, inasmuch as the Senator has referred to belligerents getting some of their oil by the hydrogenation process, let me say that some of the Senators who came back from the trip to the war fronts also told us about the rate at which American re-

serves are being depleted while the reserves of some of the same belligerents are untouched. I hope our concern for the available reserves of oil will be expressed by Senators as cogently as expression has been made elsewhere in the last 10 minutes.

Mr. President, I did not have information about the bill, so as to be able to judge accurately about it at the present time. Until 10 minutes ago, I never saw it before. I am not on the committee. No hearings were held, so far as I know. There is a report, but it is inadequate. I do know that in connection with the bill under consideration I submitted two amendments on two fundamental particulars, and both were accepted by the proponents of the bill. There may be other amendments to be proposed, Mr. President, and the passage of 72 hours before we recur to consideration of the bill will not stop the war, and will not cause the busses of Washington to cease operating.

The PRESIDING OFFICER. Is there objection to the present consideration of Senate bill 1255?

There being no objection, the bill (S. 1255) to revive and reenact the act entitled "An act creating the Arkansas-Mississippi Bridge Commission" was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted, etc., That the act approved May 17, 1939, heretofore extended by acts of Congress approved May 27, 1940, and July 14, 1941, creating the Arkansas-Mississippi Bridge Commission and authorizing such commission to construct, maintain, and operate a bridge and approaches thereto across the Mississippi River, at or near Friar Point, Miss., and Helena, Ark., be, and is hereby, revived and reenacted: *Provided*, That this act shall be null and void unless the actual construction of the bridge herein referred to be commenced within 1 year and completed within 3 years from the date of approval hereof.

Sec. 2. The right to alter, amend, or repeal this act is hereby expressly reserved.

The title was amended so as to read: "A bill to revive and reenact the act entitled 'An act creating the Arkansas-Mississippi Bridge Commission'; defining the authority, power, and duties of said commission; and authorizing said commission and its successors and assigns to construct, maintain, and operate a bridge across the Mississippi River at or near Friar Point, Miss., and Helena, Ark., and for other purposes', approved May 17, 1939."

MISSISSIPPI RIVER BRIDGE AT BROOKLYN CENTER, MINN.

The bill (H. R. 2649) to revive and reenact the act entitled "An act granting the consent of Congress to the State of Minnesota to construct, maintain, and operate a free highway bridge across the Mississippi River at or near the village of Brooklyn Center, Minn., approved April 20, 1942, was considered, ordered to a third reading, read the third time, and passed.

PAYMENT TO MEMBERS OF SANTA CLARA PUEBLO OF NEW MEXICO

The bill (H. R. 128) to authorize a per capita payment of \$10 to the members of the Santa Clara Pueblo of New Mexico

from funds on deposit to their credit in the Treasury of the United States, was considered, ordered to a third reading, read the third time, and passed.

TRANSFER OF LANDS OF CROATAN NATIONAL FOREST, N. C.

The bill (S. 1315) providing for the transfer to the custody and control of the Secretary of the Navy of certain lands comprising a portion of Croatan National Forest in the State of North Carolina was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted, etc., That the Secretary of Agriculture is authorized and directed to transfer to the custody and control of the Secretary of the Navy all lands owned by the United States and comprising a part of Croatan National Forest in the State of North Carolina which are situated within the present boundaries of the Marine Corps Aviation Base, Cherry Point, N. C.: *Provided*, That in the event the area transferred pursuant to the provisions of this act shall cease to be used for military purposes, it shall revert to its former national-forest status.

TRANSPORTATION OF DEPENDENTS AND HOUSEHOLD EFFECTS OF PERSONNEL OF NAVY, MARINE CORPS, AND COAST GUARD

The bill (S. 1336) to authorize the transportation of dependents and household effects of personnel of the Navy, Marine Corps, and Coast Guard under certain conditions, and for other purposes, was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted, etc., That officers and enlisted men of the Navy, Marine Corps, and Coast Guard, and the reserve components thereof when on active duty, of grades entitling them to transportation of dependents and household effects on change of station (a) when on duty at places designated by the Secretary of the Navy as within zones from which their dependents should be evacuated for military reasons or for the purpose of relieving congestion in the vicinity of naval activities or where Government quarters for their dependents are not available; (b) or upon transfer or assignment of such officers and enlisted men to sea duty, as such duty may be defined by the Secretary of the Navy; (c) or upon transfer or assignment of such officers and enlisted men to duty at places where their dependents for military reasons are not permitted to join them or where Government quarters for their dependents are not available, may, upon application of such personnel or their dependents, be allowed, subject to such regulations as the Secretary of the Navy may prescribe, transportation for their dependents and household effects, including packing, crating, and unpacking thereof, from their stations or places of storage in the United States to any other points in the United States, and from such points to new stations in the United States to which such personnel may be subsequently ordered for duty, and at which their dependents are not restricted from joining them or Government quarters for their dependents are available.

Sec. 2. Whenever the Chief of Naval Personnel, Commandant of the Marine Corps, Commandant of the Coast Guard, or such subordinates as they may designate, certify that the personnel included in (b) and (c) of section 1 hereof have been transferred to sea duty or to duty at places beyond the continental limits of the United States where their dependents for military reasons are not permitted to join them, the wives of such

personnel, or such other responsible persons as may be designated by the officials named above in this section, may execute such certificates as may be required and which are filed with, and relate to, vouchers in connection with the transportation of dependents or household effects: *Provided*, That in lieu of copies of orders of such personnel, the certificate above provided for shall constitute authority for such transportation of dependents, and household effects as may be authorized hereunder and any certificate or certification authorized by this act shall be final and conclusive upon the accounting officers of the Government: *And provided further*, That under such regulations as the Secretary of the Navy may prescribe, claims for reimbursement may be submitted by and payments made to personnel concerned or their dependents for any authorized travel performed by dependents at their own expense.

Sec. 3. The Comptroller General of the United States is hereby authorized and directed to allow credit in the accounts of disbursing officers in cases where such dependents would have been entitled to transportation if the provisions of section 1 hereof had been in effect on the date of payment for otherwise proper payments heretofore made to transportation of dependents, or reimbursement therefor, under orders issued prior to the effective date of this act, to the extent of the commercial cost of transportation of the dependents from the old-duty station to the new-duty station. Such cost of transportation shall be computed from the last available published rates on the date the orders involved were issued.

Sec. 4. Transportation of household effects of naval and civilian personnel of the Naval Establishment, as now or hereafter authorized by law, may, under such regulations as the Secretary of the Navy shall prescribe, be by means of rail, water, or van, without regard to comparative costs.

Sec. 5. This act shall be effective as of December 7, 1941, and shall remain in effect for the duration of the present wars and for 6 months after the termination of such wars, or until such earlier time as the Congress by concurrent resolution or the President by proclamation may designate.

CONVEYANCE TO CITY OF NEW YORK OF CERTAIN LANDS WITHIN THE BROOKLYN NAVY YARD

The bill (S. 1349) to authorize the Secretary of the Navy to convey to the city of New York certain lands within the Brooklyn Navy Yard in the city of New York was considered, ordered to be engrossed for a third reading, read the third time, and passed, as follows:

Be it enacted, etc., That the Secretary of the Navy be, and he is hereby, authorized to transfer, under such conditions as may be approved by the said Secretary, to the city of New York, all right, title, and interest of the United States in and to a parcel of land containing three-tenths of an acre, more or less, located on the westerly side of a new street between Kent Avenue and Flushing Avenue, and in and to a strip of land 27 feet wide, located on the southerly side of Kent Avenue between Washington Avenue and Hewes Street, in the Borough of Brooklyn, city and State of New York, both of said parcels being within the boundaries of lands acquired for the expansion of the Brooklyn Navy Yard, and metes and bounds of descriptions of which are on file in the Navy Department.

SETTLEMENT OF ACCOUNTS OF DECEASED OFFICERS AND ENLISTED MEN OF THE NAVY AND MARINE CORPS

The bill (S. 1351) to amend the Act of May 27, 1908, as amended, authorizing

REPORTS OF COMMITTEES ON PUBLIC BILLS AND RESOLUTIONS

Under clause 2 of rule XIII, reports of committees were delivered to the Clerk for printing and reference to the proper calendar, as follows:

Mr. PATMAN: Third interim report of the Committee on Small Business, pursuant to House Resolution 18, creating a Select Committee on Small Business of the House of Representatives and defining its powers and duties; without amendment (Rept. No. 809). Referred to the Committee of the Whole House on the state of the Union.

Mr. BELL: Committee on Insular Affairs. S. 981. An act to assist in relieving economic distress in Puerto Rico and the Virgin Islands by providing work for unemployed persons, and for other purposes; without amendment (Rept. No. 810). Referred to the Committee of the Whole House on the state of the Union.

Mr. PETERSON of Florida: Committee on the Public Lands. H. R. 3428. A bill to amend sections 6, 7, and 8 of the act entitled "An act to provide for the leasing of coal lands in the Territory of Alaska, and for other purposes," approved October 20, 1914 (38 Stat. 741, 743; 48 U. S. C., secs. 440, 441, 442); without amendment (Rept. No. 811). Referred to the Committee of the Whole House on the state of the Union.

Mr. HOBBS: Committee on the Judiciary. S. 630. An act to amend section 107 of the Judicial Code, as amended, to change the terms of the District Court for the Middle District of Tennessee; with amendment (Rept. No. 820). Referred to the Committee of the Whole House on the state of the Union.

Mr. RANDOLPH: Committee on Mines and Mining. H. R. 3209. A bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes; with amendment (Rept. No. 821). Referred to the Committee of the Whole House on the state of the Union.

REPORTS OF COMMITTEES ON PRIVATE BILLS AND RESOLUTIONS

Under clause 2 of rule XIII, reports of committees were delivered to the Clerk for printing and reference to the proper calendar, as follows:

Mr. SCRIVNER: Committee on Claims. S. 759. An act conferring jurisdiction upon the United States District Court for the Eastern District of Tennessee to hear, determine, and render judgment upon the claim of W. I. Dooly; without amendment (Rept. No. 812). Referred to the Committee of the Whole House.

Mr. JENNINGS: Committee on Claims. S. 770. An act for the relief of Eddie Percle; without amendment (Rept. No. 813). Referred to the Committee of the Whole House.

Mr. SCRIVNER: Committee on Claims. S. 862. An act for the relief of the Grafton Boat Works; without amendment (Rept. No. 814). Referred to the Committee of the Whole House.

Mr. SCRIVNER: Committee on Claims. S. 950. An act for the relief of the Milford Trust Co. and Blanche R. Bennett, as administrators of the estate of Charles E. Reed, deceased; without amendment (Rept. No. 815). Referred to the Committee of the Whole House.

Mr. PATTON: Committee on Claims. S. 1246. An act for the relief of Ervin S. Finley; without amendment (Rept. No. 816). Referred to the Committee of the Whole House.

Mr. ABERNETHY: Committee on Claims. S. 1309. An act for the relief of Pan Ameri-

can Airways, Inc.; without amendment (Rept. No. 817). Referred to the Committee of the Whole House.

Mr. JENNINGS: Committee on Claims. H. R. 2005. A bill for the relief of Christine Mangrum, Luster Mangrum, and Nathan Mangrum; with amendment (Rept. No. 818). Referred to the Committee of the Whole House.

Mr. BLOOM: Committee on Foreign Affairs. S. 1382. An act for the relief of certain officers and employees of the Foreign Service of the United States who, while in the course of their respective duties, suffered losses of personal property by reason of war conditions; without amendment (Rept. No. 819). Referred to the Committee of the Whole House.

PUBLIC BILLS AND RESOLUTIONS

Under clause 3 of rule XXII, public bills and resolutions were introduced and severally referred as follows:

By Mr. MANSFIELD of Montana:

H. R. 3570. A bill to provide as an emergency war project for the partial construction of the Hungry Horse Dam on the South Fork of the Flathead River in the State of Montana, and for other purposes; to the Committee on Irrigation and Reclamation.

By Mr. BELL:

H. R. 3571. A bill providing for the incorporation of the National Council of Negro Veterans; to the Committee on the Judiciary.

By Mr. FULMER:

H. R. 3572. A bill to amend the Bankhead-Jones Farm Tenant Act and the Rural Electrification Act, to provide other aids to agriculture, and for other purposes; to the Committee on Agriculture.

By Mr. GEARHART:

H. R. 3573. A bill to provide for the reincorporation of the National Woman's Relief Corps, Auxiliary to the Grand Army of the Republic; to the Committee on the Judiciary.

By Mr. HARRIS of Arkansas:

H. R. 3574. A bill to regulate boxing contests and exhibitions in the District of Columbia, and for other purposes; to the Committee on the District of Columbia.

By Mr. JONKMAN:

H. R. 3575. A bill relating to certain creditor reorganizations under chapter 1 of the Internal Revenue Code; to the Committee on Ways and Means.

By Mr. BLAND:

H. R. 3576. A bill relating to the time within which contributions into State unemployment funds must be made to secure credit against the tax imposed by the Federal Unemployment Tax Act; to the Committee on Ways and Means.

By Mr. BROOKS:

H. R. 3577. A bill to deny admittance into the United States to all immigrants while the number of unemployed persons within the United States is 1,000,000 or more; to the Committee on Immigration and Naturalization.

H. R. 3578. A bill to provide for a national cemetery in northwest Louisiana in the vicinity of Shreveport, in the State of Louisiana; to the Committee on Military Affairs.

By Mr. MURDOCK:

H. R. 3579. A bill providing for the suspension of certain requirements relating to work on tunnel sites; to the Committee on Mines and Mining.

By Mr. PATMAN:

H. R. 3580. A bill to provide for the conservation and proper disposal of surplus war properties, and for other purposes; to the Committee on Expenditures in the Executive Departments.

By Mr. PHILLIPS:

H. R. 3581. A bill to grant to persons serving under the command of Gen. Emilio Agu-

naldo in the campaign against the city of Manila, P. I., the right to wear the Spanish campaign ribbon and badge; to the Committee on Military Affairs.

By Mr. WILLEY:

H. R. 3582. A bill to provide for one national cemetery in every State and such other national cemeteries in the States, Territories, and possessions as may be needed for the burial of war veterans; to the Committee on Military Affairs.

By Mr. SAUTHOFF:

H. J. Res. 180. Joint resolution proposing an amendment to the Constitution providing for the election of district judges of the district courts of the United States for 6-year terms; to the Committee on the Judiciary.

By Mr. LUDLOW:

H. Con. Res. 50. Concurrent resolution to welcome the people of Italy to the family of liberated nations; to the Committee on Foreign Affairs.

By Mr. WELCH:

H. Res. 337. Resolution recommending to the Secretary of the Navy that he give immediate, full, and thorough consideration to the solution of the problem of in-plant feeding at shipyards and shipbuilding plants under his jurisdiction; to the Committee on Naval Affairs.

By Mr. RANKIN:

H. Res. 338. Resolution providing for the consideration of H. R. 3377, a bill to increase the rate of pension to World War veterans from \$40 to \$50 per month, and for other purposes; to the Committee on Rules.

H. Res. 339. Resolution providing for the consideration of H. R. 3356, a bill to provide for an increase in the monthly rates of compensation or pension payable to disabled veterans for service-incurred disability and to widows and children under Public Law 484, Seventy-third Congress, June 28, 1934, as amended; to the Committee on Rules.

PRIVATE BILLS AND RESOLUTIONS

Under clause 1 of rule XXII, private bills and resolutions were introduced and severally referred as follows:

By Mr. CURLEY:

H. R. 3583. A bill for the relief of James H. Powell; to the Committee on Claims.

By Mr. CARTER:

H. R. 3584. A bill for the relief of Elsie Hawke and Charles Hawke; to the Committee on Claims.

By Mr. CANNON of Florida:

H. R. 3585. A bill for the relief of Mrs. Luther S. Sykes; to the Committee on Claims.

H. R. 3586. A bill for the relief of Mrs. John Andrew Godwin; to the Committee on Claims.

By Mr. CLARK:

H. R. 3587. A bill for the relief of W. D. Jones and Ethel S. Jones; to the Committee on Claims.

By Mr. SMITH of West Virginia:

H. R. 3588. A bill for the relief of Carl M. Frasure; to the Committee on Claims.

By Mr. PLOESER:

H. R. 3589 (by request). A bill for the relief of the Royal Exchange Assurance Co.; to the Committee on Claims.

By Mr. WELCH:

H. R. 3590. A bill for the relief of the city and county of San Francisco; to the Committee on Claims.

PETITIONS, ETC.

Under clause 1 of rule XXII, petitions and papers were laid on the Clerk's desk and referred as follows:

3325. By Mr. SCHIFFLER. Petition of sundry patrons of Fulton Tavern, of Wheeling, W. Va., opposing House bill 2082; to the Committee on the Judiciary.

3326. By Mr. PLOESER: Petition of Alfred J. Fielscher and 27 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3327. Also, petition of John Casey and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3328. Also, petition of Joseph J. Knezevich and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3329. Also, petition of John Briley and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3330. Also, petition of John Binguin, Jr., and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3331. Also, petition of Thomas W. Fahey and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3332. Also, petition of Henry Hoog and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3333. Also, petition of Clarence V. Simpsen and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3334. Also, petition of Ferd M. Litsch and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3335. Also, petition of Frederick W. Etling and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3336. Also, petition of Harry Streitz and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3337. Also, petition of Louis E. Renner and 20 others, of St. Louis, Mo., protesting against the enactment of any and all prohibition legislation; to the Committee on the Judiciary.

3338. By Mr. LEWIS of Ohio: Petition of Rev. R. P. Lippincott and five other citizens of Cadiz, Ohio, urging passage of House bill 2082; to the Committee on the Judiciary.

3339. By Mr. KING: Letter from Rev. P. Meredith McCluer, pastor, Manchester Avenue Christian Church of Los Angeles, Calif., and petition signed by members of that church, urging the passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3340. Also, petition signed by members of the South Lomita Church, of Lomita, Calif., Rev. Urban Hall, pastor, urging the passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and the termination of demobilization; to the Committee on the Judiciary.

3341. Also, letter from Rev. W. A. Penner, pastor of the Nazarene Church, and petition signed by members of the Nazarene Church of Torrance, Calif., urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for

the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3342. Also, letter received from Rev. Paul H. Perry, pastor of the Assembly of God Church, of Torrance, Calif., and petition signed by members of that church, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3343. Also, letter received from Rev. R. DeWitt Howell, pastor of the First Church of God, Los Angeles, Calif., and petition signed by members of that church, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3344. Also, petition signed by members of the Bethel Methodist Church, of Los Angeles, Calif., Dr. W. T. Gilliland, pastor, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3345. Also, petition signed by members of the Community Presbyterian Church, of Lomita, Calif., Rev. John E. Orr, pastor, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3346. Also, petition of Mrs. M. Hewitt and signed by members of the Calvary Church, of Lomita, Calif., Rev. James Lynd, pastor, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3347. Also, letter received from Rev. Ernest O. Forde, pastor of Sunnyside Baptist Church, of Los Angeles, Calif., and petition signed by members of this church, urging passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3348. Also, letter received from Rev. Harry Branton, pastor of Torrance Methodist Church, Torrance, Calif., and petitions signed by members of his congregation, urging the passage of the Bryson bill, H. R. 2082, which would prohibit the manufacture, sale, or transportation of alcoholic liquor in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3349. Also, petition of Mr. and Mrs. Edward Lee, of Torrance, Calif., to reduce absenteeism, conserve manpower, and speed production of materials necessary for the winning of the war by prohibiting the manufacture, sale, or transportation of alcoholic liquors in the United States for the duration of the war and until the termination of demobilization, and therefore requesting Congress to pass House bill 2082, introduced by Hon. JOSEPH R. BRYSON, of South Carolina; to the Committee on the Judiciary.

3350. Also, petition of Mr. and Mrs. T. C. Bowen, of Inglewood, Calif., to reduce absenteeism, conserve manpower, and speed production of materials necessary for the winning of the war, by prohibiting the manufacture, sale, or transportation of alcoholic liquors in the United States for the duration of the war and until the termination of demobilization, and therefore requesting Congress to pass

House bill 2082, introduced by Hon. JOSEPH R. BRYSON, of South Carolina; to the Committee on the Judiciary.

3351. By Mr. HORAN: Petition of Louisa C. Paterson and 19 other residents of Spokane, Wash., to reduce absenteeism, conserve manpower, and speed production of materials necessary for the winning of the war, by prohibiting the manufacture, sale, or transportation of alcoholic liquors in the United States for the duration of the war; to the Committee on the Judiciary.

3352. By Mr. HOLMES of Washington: Petition of sundry citizens of Sunnyside, Mabton, Outlook, Grandview, and Walla Walla, Wash., urging enactment of House bill 2082, to prohibit the manufacture, sale, or transportation of alcoholic liquors in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3353. Also, petition of 194 citizens of Pomeroy, Wash., urging enactment of House bill 2082, to prohibit the manufacture, sale, or transportation of alcoholic liquors in the United States for the duration of the war and until the termination of demobilization; to the Committee on the Judiciary.

3354. By Mr. CARTER: Petition of the Contra Costa County Taxpayers' Association, Martinez, Calif., urging the enactment of a general sales tax and a rigid program of economy by the Federal Government as a means of yielding the balance of needed revenues for war purposes; to the Committee on Ways and Means.

3355. By Mr. SMITH of Wisconsin: Petition of the Pure Milk Products Cooperative, Fond Du Lac, Wis.; to the Committee on Agriculture.

3356. By Mr. FORD: Resolution of the Western Cooperative Dairymen's Union, supporting the fight to prevent inflation by allowing funds from Commodity Credit Corporation to be used for providing cost of production to dairymen through subsidies when necessary; to the Committee on Ways and Means.

3357. By Mr. ROLPH: Resolution adopted by California Commission on Interstate Cooperation, that the construction of the entire Central Valley project be expedited and completed at the earliest possible date, for the immediate purpose of providing additional food and electric power for war needs and the further purpose of realizing the project's original objectives of preserving existing agricultural production and developments, maintaining municipal and industrial developments, and providing for improvement of navigation, flood control, and development of hydroelectric power; and urging Congress to appropriate the necessary funds and the War Production Board to grant priorities for the required material, equipment, and manpower to complete the project as expeditiously as practicable; to the Committee on the Public Lands.

3358. Also, resolution of the Railroad Commission of the State of California, opposing House bill 3420; to the Committee on Interstate and Foreign Commerce.

3359. Also, petition of the California State Board of Agriculture, Sacramento, Calif., recommending that Shasta, Keswick, and Friant Dams, Friant-Kern, Madero, and Contra Costa Canals, and other necessary works of the Central Valley project, be completed and placed in operation as rapidly as feasible for the purpose of obtaining increased production of critical war crops to meet the increased food shortage, and that the Secretary of Agriculture, the Food Administrator, and War Production Board are urged to approve the necessary materials required, and that the Congress appropriate adequate funds therefor; to the Committee on the Public Lands.

3360. By Mr. COCHRAN: Petition of the Potomac Boat Club, Washington, D. C., and

AUTHORIZING CONSTRUCTION OF DEMONSTRATION PLANTS TO PRODUCE SYNTHETIC LIQUID FUELS FROM COAL AND OTHER SUBSTANCES

NOVEMBER 1, 1943.—Committed to the Committee of the Whole House on the
state of the Union and ordered to be printed

Mr. RANDOLPH, from the Committee on Mines and Mining, submitted
the following

R E P O R T

[To accompany H. R. 3209]*

The Committee on Mines and Mining, to whom was referred the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having considered the same, report favorably thereon with amendments and recommend that the bill as amended do pass.

The amendments are as follows:

On page 2, line 2, after the word "products" add the following insert:

The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this Act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

On page 3, line 2, strike the word "private".

On page 3, line 2, after the comma following the word "firm", insert "educational institution,".

On page 4, following section 5, add:

SEC. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this Act.

The Secretary of the Interior is authorized by this act—

(1) To conduct laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation;

(2) To acquire, by purchase, lease for a term of years or less, donation, or otherwise, land and any interest in land including easements and leasehold interests, options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of such property;

(3) To engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable; and

(4) To cooperate with any Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation, in effectuating the purposes of this act.

This act authorizes an appropriation not to exceed \$30,000,000.

The purpose of this bill is to assure the United States a continuous supply of domestically produced motor fuel and aviation gasoline by authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances.

The decline in the rate at which new discoveries of oil fields are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The implications of the progressive effect of this decline on peacetime economy of the post-war years are easily foreseen and can effectively be forestalled by timely action. The answer to the problem clearly lies in intelligent planning now for the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

The military demands for petroleum and its products during this global war have been so great that we are now burning liquid fuel at the rate of 1,500,000 barrels of crude oil every year. This tremendous drain on American supplies has been occasioned by the fact that the United States oil fields have been considered the only sure and certain source of supply for the armies, the navies, and the air forces of all the United Nations. Even though the recovery of the Mediterranean Sea from the Axis control is now opening up middle eastern sources of oil, the demand for American supplies is likely to continue at a tremendously high rate because the American air fleets are constantly being augmented. More and larger aircraft of longer flying radius are under construction and the demand for these planes will not be appreciably diminished while the war continues.

The consumption of oil in the United States, as pointed out, is proceeding annually at a rate greater than the discovery of new supplies. During the years 1940, 1941, and 1942, the additions to proven oil reserves of the Nation amounted to an aggregate of approximately 1.6 billion barrels of crude oil as compared with additions of 5.4 billion barrels in the preceding 3 years. The rate of discovery has been steadily declining, and while your committee is of the opinion that the search for oil in the public-land States can be successfully stimulated, it is, nevertheless, evident that the demand for liquid fuel is likely to continue at such a high rate that the country's interest can be conserved only by immediate action to bring about the manufacture of

synthetic liquid fuel from the almost unlimited supplies of coal which this country possesses, and the vast deposits of oil shale to be found in the several public-land States.

The United States now occupies a position of world leadership in the field of aviation, and there can be no doubt now that aviation will be one of the principal post-war industries. This is true not only because of the genius and skill of its citizens who are engaged in the design and manufacture of airplanes, but because we have had a large supply of crude oil. If we are to maintain our leadership in the air, immediate steps must be taken to guarantee a continuing and certain supply of liquid fuel. This can be done by the use of coal, oil shale, and other materials for the manufacture of synthetic liquid fuel. In Germany, Japan, and England, the hydrogenation of coal has been a source of supply. The process has not been used in the United States largely because of the cost, and industry has not as yet undertaken to demonstrate the possibilities.

Early in 1942 the chairman of the House Mines and Mining Committee appointed a subcommittee to study the feasibility of this field of productivity. That group has investigated the subject in an intensive manner. Its work is continuing.

During the recent recess of Congress, a Senate Subcommittee on Public Lands and Surveys, in cooperation with the subcommittee of the Mines and Mining Committee of the House, held hearings at Washington, D. C., Pittsburgh, Pa., Salt Lake City, Utah, and Sheridan, Wyo. Opportunity was extended to all branches of industry to discuss the measure. The response, not only from industry but also from public authorities in the coal-bearing States, was little short of enthusiastic. Only one doubt was expressed; namely, that the authority might be used to put the Government in competition with private industry. This was not the intention of the sponsor of the bill, nor of the Department of the Interior, and statements to that effect were made at the hearings. In order to make the matter clear, however, the committee, at the recommendation of the subcommittee which conducted the hearings, has adopted the amendments on pages 2 and 3 of the bill which are set forth in full above, to make certain that there will be no invasion of the domain of private industry and no competition by Government with commercial enterprise.

The report of the Secretary of the Interior is made a part of this report.

At the present time, the United States Bureau of Mines, acting under the authorization of a congressional appropriation, is making experiments in a small plant at the Bureau of Mines station located at Pittsburgh, Pa. These laboratory tests, which have been successfully carried forward, have proceeded to such a point that it is now desirable to carry them on in a more extensive manner in order that work today may prepare us to meet the needs of America, not only with our people at war but in the period of peace which will follow the defeat of our enemies.

THE SECRETARY OF THE INTERIOR,
Washington 25, D. C., October 27, 1943.

HON. JOE L. SMITH,
*Chairman, Committee on Mines and Mining,
House of Representatives.*

MY DEAR MR. SMITH: You have asked my views on the provisions of H. R. 3209, a bill authorizing the construction and operation of demonstration plants to

produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

I am wholeheartedly in favor of the legislation proposed in the bill. It is high time that the country embarked in earnest upon the program of research and development work necessary to determine the processes and equipment required for the establishment of an industry which can help to supply the continuing needs of the country for liquid fuels which have heretofore been available from the ample but now waning domestic petroleum reserves.

The total demand for liquid fuel in 1941 and 1942 reached about 1.5 billion barrels annually. The rate of discovery of petroleum has decreased sharply since 1937. In the 3 years 1937-39 about 5.4 billion barrels were added to the Nation's proved oil reserves, whereas in the 3 years 1940-42 the increment was only 1.6 billion barrels. In 1942, the new reserves discovered, including extensions and new horizons in old fields, were at a low of 317,000,000 barrels or only about one-fifth of our annual rate of consumption. This failure to find adequate quantities of new oil was not due to lack of prospect drilling, as 3,264 wildcat wells were drilled in 1941 and 3,029 in 1942. The decline in the rate at which new discoveries are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The ominous implications of the progressive effect of this decline upon the peacetime economy of the post-war years are easily foreseen and can be effectively forestalled by timely action. The answer to the problem clearly lies in the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

It is apparent that this country can no longer delay in embarking upon a synthetic liquid-fuel program. Our study of petroleum reserves and the rate of their depletion indicates clearly that unless we take action, the end of the age of abundant oil is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, the Department of the Interior has been aware of these trends and has initiated the study of means which may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

However, the time has come when we must get out of the test-tube stage into actual production. Past experiments have given us the scientific knowledge of the basic processes involved, but the way must be blazed for American industry to enter this synthetic fuel field, which inevitably will be one of the major industrial developments of the near future.

It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly. Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up the work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that private enterprise can take up the task of providing synthetic fuels on the scale necessary to safeguard the Nation's future.

In order to clarify the scope of the operations intended to be authorized by H. R. 3209, I recommend that the following language be inserted after the word "products" at page 2, line 2, of the bill:

"The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products."

The Department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

Sincerely yours,

ABE FORTAS,
Acting Secretary of the Interior.

Union Calendar No. 289

78TH CONGRESS
1ST SESSION

H. R. 3209

[Report No. 821]

IN THE HOUSE OF REPRESENTATIVES

SEPTEMBER 14, 1943

Mr. RANDOLPH introduced the following bill; which was referred to the Committee on Mines and Mining

NOVEMBER 1, 1943

Reported with amendments, committed to the Committee of the Whole House on the state of the Union, and ordered to be printed

[Insert the part printed in italic]

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*
3 That the Secretary of the Interior, acting through the Bureau
4 of Mines, within the limits of critical materials available, is
5 authorized to construct, maintain, and operate one or more
6 demonstration plants to produce synthetic liquid fuels from
7 coal and other substances with all facilities and accessories

1 for the manufacture, purification, storage, and distribution
2 of the products. *The plants shall be of the minimum size*
3 *which will allow the Government to furnish industry the*
4 *necessary cost and engineering data for the development of a*
5 *synthetic liquid fuel industry and of such size that the com-*
6 *bined product of all the plants constructed in accordance with*
7 *this Act will not constitute a commercially significant amount*
8 *of the total national commercial sale and distribution of*
9 *petroleum and petroleum products.*

10 SEC. 2. In order to carry out the purpose of this Act,
11 the Secretary of the Interior is authorized—

12 (a) to conduct laboratory research and develop-
13 ment work necessary to determine the best demonstra-
14 tion plant designs and conditions of operation;

15 (b) to acquire, by purchase, lease for a term of
16 years or less, donation, or otherwise, land, and any in-
17 terest in land, including easements and leasehold inter-
18 ests; options on real or personal property; plants and
19 their facilities; secret processes, technical data, inven-
20 tions, patent applications, patents, irrevocable nonexclu-
21 sive licenses, and other rights and licenses under patents
22 granted by this or any other nation; to assume the obli-
23 gation to pay rentals in advance on property so acquired,
24 and to pay damages arising out of the use of any such
25 property;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, *educational institution*, or corporation, in effectuating the purposes of this Act.

Sections 321 and 322 of the Act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State Government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property ac-

1 quired, but in his opinion no longer useful, for the purposes
2 of this Act, and to grant, on such terms as he may consider
3 appropriate, licenses under patent rights acquired under this
4 Act.

5 SEC. 4. All moneys received under this Act for products
6 of the plants and royalties shall be paid into the Treasury
7 as miscellaneous receipts. The Secretary of the Interior shall
8 render to Congress on or before the 1st day of January of
9 each year a report of all operations under this Act.

10 SEC. 5. The Secretary of the Interior may issue rules
11 and regulations to effectuate the purposes of this Act. The
12 authority and duties of the Secretary of the Interior under this
13 Act shall be exercised through the Bureau of Mines of the
14 Department of the Interior.

15 *SEC. 6. There is authorized to be appropriated not to*
16 *exceed the sum of \$30,000,000 to carry out the provisions*
17 *of this Act.*

78TH CONGRESS
1ST SESSION

H. R. 3209

[Report No. 821]

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

By Mr. RANDOLPH

SEPTEMBER 14, 1943

Referred to the Committee on Mines and Mining

NOVEMBER 1, 1943

Reported with amendments, committed to the Committee of the Whole House on the state of the Union, and ordered to be printed

Calendar No. 451

78TH CONGRESS
1ST SESSION

S. 1243

[Report No. 445]

Calendar No. 451

78TH CONGRESS
1ST SESSION

S. 1243

[Report No. 445]

IN THE SENATE OF THE UNITED STATES

JUNE 18 (legislative day, MAY 24), 1943

Mr. O'MAHONEY introduced the following bill; which was read twice and referred to the Committee on Public Lands and Surveys

OCTOBER 6 (legislative day, SEPTEMBER 15), 1943

Reported by Mr. O'MAHONEY, with amendments

[Insert the part printed in italic]

NOVEMBER 5 (legislative day, OCTOBER 25), 1943

Ordered to be printed showing amendments agreed to October 12, 1943

[Amendments agreed to in bold-face type and line type]

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

- 1 *Be it enacted by the Senate and House of Representa-*
- 2 *tives of the United States of America in Congress assembled,*
- 3 That the Secretary of the Interior, acting through the
- 4 Bureau of Mines, within the limits of critical materials
- 5 available, is authorized to construct, maintain, and operate
- 6 one or more demonstration plants to produce synthetic liquid

1 fuels from coal and other substances with all facilities and
2 accessories for the manufacture, purification, storage, and
3 distribution of the products. **There is hereby authorized to**
4 **be appropriated not to exceed \$30,000,000 for the purposes**
5 **of this Act.** *The plants shall be of the minimum size which*
6 *will allow the Government to furnish industry the necessary*
7 *cost and engineering data for the development of a synthetic*
8 *liquid fuel industry and of such size that the combined prod-*
9 *uct of all the plants constructed in accordance with this Act*
10 *will not constitute a commercially significant amount of the*
11 *total national commercial sale and distribution of petroleum*
12 *and petroleum products.*

13 SEC. 2. In order to carry out the purpose of this Act,
14 the Secretary of the Interior is authorized—

15 (a) to conduct laboratory research and develop-
16 ment work necessary to determine the best demonstra-
17 tion plant designs and conditions of operation;

18 (b) to acquire, by purchase, lease for a term of
19 years or less, ~~or donation, or otherwise,~~ land and any
20 interest in land, including easements and leasehold in-
21 terests; options on real or personal property; plants
22 and their facilities; secret processes, technical data,
23 inventions, patent applications, patents, irrevocable non-
24 exclusive licenses, and other rights and licenses under
25 patents granted by this or any other nation; to assume

1 the obligation to pay rentals in advance on property so
2 acquired, and to pay damages arising out of the use of
3 any such property;

4 (c) to engage, by contract or otherwise, engineers,
5 architects, and any private industrial organization he
6 deems suitable, to do all or any part of the work of
7 designing, constructing, or operating the plants, the
8 operation to be under his supervision, and through
9 leases or otherwise as he believes advisable;

10 (d) to cooperate with any other Federal or State
11 department, agency, or instrumentality, and with any
12 private person, firm, or corporation, in effectuating the
13 purposes of this Act.

14 Sections 321 and 322 of the Act of June 30, 1932 (47
15 Stat. 412), as amended, shall not apply to any leases under
16 this section **not to exceed five**; and such leases may be made
17 for a term of years notwithstanding Revised Statutes, section
18 3679, as amended, or any other provision of law.

19 SEC. 3. The Secretary of the Interior is authorized to
20 sell the products of the plants at not more than actual cost,
21 including amortization of capital expenses, as determined by
22 him, to any department, agency, or instrumentality of the
23 Federal or any State government, but priority shall be given
24 to orders placed by the War or Navy Departments. Any
25 remaining products may be sold at going prices to any

1 purchaser *through regular commercial channels*. The Secre-
2 tary of the Interior, in his discretion, shall also have authority
3 to dispose of any lands or other real or personal property
4 acquired, but in his opinion no longer useful, for the purposes
5 of this Act, and to grant, on such terms as he may consider
6 appropriate, licenses under patent rights acquired under this
7 Act.

8 SEC. 4. All moneys received under this Act for products
9 of the plants and royalties shall be paid into the Treasury
10 as miscellaneous receipts. The Secretary of the Interior shall
11 render to Congress on or before the first day of January of
12 each year a report of all operations under this Act.

13 SEC. 5. The Secretary of the Interior may issue rules
14 and regulations to effectuate the purposes of this Act. The
15 authority and duties of the Secretary of the Interior under
16 this Act shall be exercised through the Bureau of Mines of
17 the Department of the Interior.

A BILL

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

By Mr. O'MAHONEY

JUNE 18 (legislative day, May 24), 1943

Read twice and referred to the Committee on Public Lands and Surveys

OCTOBER 6 (legislative day, SEPTEMBER 15), 1943

Reported with amendments

NOVEMBER 5 (legislative day, OCTOBER 25), 1943

Ordered to be printed showing amendments agreed to
October 12, 1943

I would join the Senator from Texas in commending the members of the subcommittee and of the full committee, but I am reminded that before last March certain Senators associated themselves together in an effort to obtain a worthwhile expression from the Senate of the United States as to foreign policy. Four Members of the Senate joined in offering a resolution on that subject.

As one of the Democratic members of that group, for myself and for my Democratic colleague the Senator from Alabama [Mr. HILL] I wish to pay my respects today to our two associates on the other side of the Chamber, the Senator from Ohio [Mr. BURTON] and the Senator from Minnesota [Mr. BALL], men of political faith opposite from that of the Senator from Alabama [Mr. HILL] and myself. We worked together through long weeks and months, traveling throughout the whole country. One of the main purposes of our association was to present to the American people a picture demonstrating that partisan politics should not be involved in our foreign relations. I think we accomplished that purpose.

Mr. President, I personally traveled in various sections of the country with Dr. JUDD, a Republican Representative from Minnesota, and another Republican Representative, Mr. LAFOLLETTE, of Indiana. I never had finer associations or more pleasant relations than I had with these estimable gentlemen.

We received support and assistance from other Members of the House of Representatives and of the Senate. Party membership was not considered. I wish to say that throughout this time never did one question of partisan difference arise on the part of any of us. We worked together, united for one purpose. I wish to express my own thanks and personal gratification to these Members of both the House and of our own group in the Senate who, as we think, worked effectively and well throughout those months.

Mr. President, it has been a pleasure for me to have had these contacts and associations. It has also demonstrated conclusively the old truth that the foreign policy of this country should begin at the water's edge, and there partisan politics must end. I hope that, whatever course future events may take, partisan politics will be entirely eliminated from consideration in our determination of the vast and important questions affecting our foreign policy, which will be ours to determine in the months to come. In our relations with other countries may we always be united as firmly as we were last Friday.

Mr. WHITE. Mr. President, the senior Senator from Texas [Mr. CONNALLY] has spoken in generous and kindly words of the members of the subcommittee who served under him, and of all the members of the Committee on Foreign Relations, who contributed to the outcome of our labors last week in perfecting and adopting the post-war resolution, so called.

Mr. President, modesty has forbidden the Senator from Texas [Mr. CONNALLY] to mention the chairman of the committee. My observation is that a committee

never rises above its chairman. The Senator from Texas, from the very beginning of this controversy and of this study, has manifested zeal, patience, and tolerance for the opinions of others. In the parliamentary sense he managed the progress of the resolution with infinite skill, and he spoke in its behalf with that eloquence which always distinguishes him.

As a minority member of the Senate Foreign Relations Committee, I want to pay tribute to his contribution to what has been accomplished.

PRODUCTION OF LIQUID FUEL FROM COAL

Mr. O'MAHONEY. Mr. President, on Friday, at the last session of the Senate, Calendar No. 451, which is S. 1243, was made the pending business of the Senate; it would automatically come before the Senate at 2 o'clock, but inasmuch as it appears that there is no other matter pressing for the attention of the Senate, I desire to enter a motion that the Senate proceed to the consideration of Calendar No. 451, Senate bill 1243.

The ACTING PRESIDENT pro tempore. The question is on the motion of the Senator from Wyoming.

The motion was agreed to; and the Senate resumed the consideration of the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, which had been reported from the Committee on Public Lands and Surveys, with amendments.

The ACTING PRESIDENT pro tempore. The Chair is advised that on a previous day the bill was considered and certain amendments were agreed to.

Mr. O'MAHONEY. Mr. President, the Senate Committee on Public Lands and Surveys has unanimously recommended the enactment of the bill now before the Senate. The House Committee on Mines and Mining has likewise made a unanimous report, on a similar bill, which was introduced in the House by the Honorable JENNINGS RANDOLPH, of West Virginia, and which is now upon the Union Calendar of the House of Representatives.

During the summer the two committees, the Senate Committee on Public Lands and Surveys and the House Committee on Mines and Mining, held joint hearings in Washington, in Pittsburgh, Pa., in Salt Lake City, Utah, and in Sheridan, Wyo. Opportunity was sought by the committee to have as widespread knowledge of the purposes of the bill as possible, and to give every person who was interested an opportunity to present his point of view.

I think there are three primary reasons why the bill should be enacted, and enacted promptly. The first of these is that our reserves of oil are steadily declining, and we should not permit ourselves in this era of the world's development to become dependent upon foreign sources of oil.

The second reason is that the military needs for gasoline and fuel oil are steadily expanding. When we consider the

quantity of gasoline that is used in the round-the-clock bombing now taking place by American bombers, it becomes evident that we are making a tremendous draft upon the fuel resources of the country and of the world.

I am told upon the authority of the War Department that 1,000 four-motor bombers engaged in a 6-hour mission will consume 1,800,000 gallons of gasoline. Four or five years ago the United States was producing less than 3,000 airplanes in a year. In October, according to the report of the War Production Board, the aircraft industry of America manufactured more than 8,200 airplanes. The new B-29, the latest model of the Flying Fortress, has been constructed with a range that outdistances any other plane ever built. The War Department has not seen fit to make any disclosure publicly of the range of this new bomber, but we know that it is a very essential instrument in carrying the war to Tokyo. We will need more and more gasoline for these purposes.

Mr. President, as Members of the Senate will observe, I have placed several charts around the walls of the Senate Chamber, and I have other charts which can be exhibited if any interest should be shown in them.

The two charts at the rear, one of which is a map of the world and the other of which is a chart showing the well densities, are particularly well adapted, I think, to prove the point I make that the bill should be passed.

The third reason I was about to cite is that in addition to increasing use for military purposes, there has been a steadily expanding demand for fuel oil and gasoline for civilian purposes, and it will be utterly impossible for the United States to maintain its position of leadership in the fields of aviation and of industry unless we have a sure and certain supply of gasoline.

The large map of the world is colored in various hues, principally red and green. The area colored in green outlines the prospective oil lands of the world. It will be observed that the area of possible oil land in the United States and in Canada is but a fraction of the possible oil land in Russia. Russia, in Europe and in Siberia, has vast expanses of territory which geologists tell us are well suited to the production of petroleum, and which have not yet been drilled for oil. The cold fact is that the future of the world, so far as oil production is concerned, belongs to Russia. How important that is may be indicated by the second chart to which I call attention—namely, the one which is labeled "Well density." There are 2 circles, one of which—the one on the right—indicates the number of oil wells which have been drilled in the United States. It shows that there are 1,000,000 wells in the 3,026,000 square miles of United States territory, or 1 well for every 3.026 square miles, whereas in all the world there are 100,000 wells in 52,754,000 square miles, or 1 well for every 527.54 square miles. In these circumstances it seems to me there can be no question that if the United States desires to maintain its leadership in industry and in

aviation, it must take the steps now in order to make sure that we shall have a satisfactory supply of liquid fuel.

Mr. President, I shall trespass upon the time of the Senate only long enough to show one other chart. It now rests upon the easel in front of the desk. It was drawn for the purpose of showing the decline of our oil reserves from 1937 to 1942. It will be observed that in 1937 the total new reserves added in the United States for that year amounted to almost 4,000,000,000 barrels, whereas in 1940 less than 2,000,000,000 barrels have been added to the reserves.

Mr. HOLMAN. Mr. President, will the Senator yield?

The PRESIDING OFFICER (Mr. JOHNSON of Colorado in the chair). Does the Senator from Wyoming yield to the Senator from Oregon?

Mr. O'MAHONEY. I am glad to yield to the Senator from Oregon.

Mr. HOLMAN. I do not understand the meaning of the term "new reserves." Of course, nothing is added to the reserves already stored in the earth.

Mr. O'MAHONEY. Probably the phrase should have been "known reserves" or "proven reserves." We are talking of the estimates of the American Petroleum Institute as to the amount of oil in the ground, as proven by drilling.

Mr. HOLMAN. Very well.

Mr. O'MAHONEY. The lower part of the chart shows how the newly discovered reserves have steadily declined. The fact is, as indicated by the number of wells which have been drilled, that in the United States the possible sources of petroleum have been thoroughly explored.

Mr. HOLMAN. In other words, we are exhausting our reservoir; are we?

Mr. O'MAHONEY. Absolutely. At this moment we are burning up more petroleum than we are adding by discovery.

Mr. WHERRY. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I am very glad to yield.

Mr. WHERRY. Does the Senator mean there is no possibility of bringing in any other reserves, even if we had done the exploration we should have done during the last 2 years?

Mr. O'MAHONEY. Oh, no.

Mr. WHERRY. Does the Senator mean the oil is not available?

Mr. O'MAHONEY. Oh, no.

Mr. WHERRY. In other words, it is available if we explore the fields we have; is that correct?

Mr. O'MAHONEY. I say some is available. How much, we do not know. I will say to the Senator that in December last the Congress passed a bill which I had the privilege of introducing, and which had been favorably reported by the Committee on Public Lands and Surveys. The bill provided that there should be a reduction of royalty for new discoveries of new deposits upon the public domain, for a period of 10 years. The theory of the bill was that the Government of the United States should hold out a reward to the pioneer, to the explorer, to the prospector for oil, and should offer him a lower royalty if he

discovered the oil which our country so greatly needs. That bill was passed by both Houses of Congress, was signed by the President, and became the law of the land. In the past year, partially as a result of the enactment of that bill, and partially also as a result of the stimulation of drilling in the State of Wyoming, approximately 100,000,000 barrels of new oil resources have been brought in. I think there can be more discoveries.

Mr. WHERRY. Mr. President, will the Senator yield for another question?

Mr. O'MAHONEY. Certainly.

Mr. WHERRY. In attending the meetings of the Special Committee to Investigate Production, Transportation, and use of Fuels in Areas West of the Mississippi River, with the Senator from Missouri [Mr. CLARK] and the Senator from Kansas [Mr. REED], I observed that it was testified at Kansas City—I do not know whether the Senator from Wyoming was present at the last hearing—

Mr. O'MAHONEY. I am not a member of the committee.

Mr. WHERRY. At any rate, the representatives of the industry itself stated in open testimony that if Secretary Ickes' recommendation that the price of crude oil be increased 35 cents a barrel had been followed they felt the result would be that new fields would be explored to such an extent that all the petroleum we would need for all uses for 6 months would be brought in. I do not know whether the Senator recalls reading that statement. Does the Senator feel that such an increase could be brought about by exploring for oil for use as gasoline and crude oil, or does the Senator think that is impossible?

Mr. O'MAHONEY. Yes, Mr. President; I think an increase could be brought about by increasing the price; but the possibilities are not sufficient to meet the needs we have when we are reducing the oil reserves.

Mr. WHERRY. I understand.

Mr. O'MAHONEY. This chart [indicating] compares coal and oil and oil shale. It will be observed that the possible oil is only a fraction of the possible oil to be recovered or extracted from oil shale, whereas both together are only a fraction of our coal reserves which, under the hydrogenation process which is the subject of this bill, could be used for the production of oil.

Mr. HOLMAN. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield to the Senator from Oregon.

Mr. HOLMAN. In our State we have lignite coal, which, as the Senator understands, is the lowest form of coal.

Mr. O'MAHONEY. I did not know there was anything in Oregon which could be called the lowest form of any commodity. [Laughter.]

Mr. HOLMAN. I shall have to add to the record there. Let me inquire whether lignite coal is a source of liquid fuel.

Mr. O'MAHONEY. Lignite coal can be used. All types of coal can be used. The truth of the matter is that the process of hydrogenation is actually a scien-

tific duplication of the process of nature by which petroleum is made.

Some years ago the Congress made an appropriation for the Bureau of Mines to provide for the establishment of a laboratory plant at Pittsburgh. This plant was visited by the committee. The senior Senator from Pennsylvania [Mr. DAVIS], who is present at this moment, and his colleague [Mr. GUFFEY], the junior Senator from Pennsylvania, were both at the Bureau of Mines Laboratory at the time the committee visited it. There coal is subjected to tremendous heat and tremendous pressure. At this high degree of heat and under this tremendous pressure hydrogen gas is forced into the coal, and chemically the coal is actually transformed into petroleum. The result is that the gasoline and oil derived from the hydrogenation process are in every respect identical with the products made from petroleum. The only question is whether or not we intend now to take time by the forelock and provide that the United States shall not in any circumstances run short of a sure supply of fuel. It is an expensive process. There can be no doubt about that. The laboratory at Pittsburgh uses a ton or two tons of coal a day. I believe that is the capacity of the plant. The Senator from South Dakota [Mr. GURNEY], who was present at the hearing, can correct me if I have misstated it.

Mr. GURNEY. I am quite sure it is not that large.

Mr. O'MAHONEY. Is it even less than that?

Mr. GURNEY. Yes. It is approximately 200 pounds.

Mr. O'MAHONEY. I thank the Senator. As I now recall, the Senator is correct. That toy plant at Pittsburgh is not sufficient to make the commercial test which should be made so that we may not face a shortage in oil such as we faced in rubber, for example. The purpose of the bill is to authorize the Department of the Interior to establish demonstration plants which will open the door to private industry to manufacture synthetic liquid fuel in large volume when the need arises.

Mr. MILLIKIN. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. MILLIKIN. I think the hydrogenation process is peculiarly adapted to coal, whereas it might or might not be adapted to oil shale. The Senator does not intend to foreclose the use of other experimental processes so far as oil shales are concerned, does he?

Mr. O'MAHONEY. Certainly not. Any process which can be developed ought to be developed. There are two processes which have been used—the so-called Burgess process and the Fischer-Tropsch process. Both those processes were discovered by German scientists. Germany used both processes for the purpose of manufacturing the gasoline with which Hitler undertook the conquest of the world. The bill is intended to afford scientific experimentation with respect to all these processes and any new ones which may be developed. It would make the Government a pioneer

in conducting studies in the public interest. Such studies cannot be undertaken, and have not been undertaken by private industry because of the expense involved.

Mr. MILLIKIN. Mr. President, will the Senator further yield?

Mr. O'MAHONEY. I yield.

Mr. MILLIKIN. In the early 1920's the president of the Colorado School of Mines and one or two associates on the faculty of that institution came to Congress with a complete laboratory oil shale retorting plant. It was set up in one of the committee rooms and demonstrated to Senators and Representatives who were interested that oil could be produced from oil shale. So there is a precedent for a Government interest in both branches of the subject—both coal and oil shale.

Mr. O'MAHONEY. I thank the Senator. I may add that only last Saturday Hon. JENNINGS RANDOLPH, of West Virginia, who sponsored the bill in the House of Representatives, flew from Martinsburg, in his State, to Washington in a Fairchild plane which was fueled by aviation gasoline made from coal in the Pittsburgh plant.

Mr. MILLIKIN. I should add that subsequent to the demonstration to which I referred, Senator Phipps, of Colorado, sponsored an appropriation which resulted in the oil shale experimental plant at Rulison, Colo.

Mr. O'MAHONEY. The Senator is correct. I think it was in 1928 or 1929 that the Bureau of Mines conducted those experiments. There are huge deposits of oil shale in Colorado, Utah, and Wyoming, which the scientists estimate are capable of producing 92,000,000,000 barrels of oil. That is more than three times greater than our present known reserves of petroleum.

Mr. TAFT. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. TAFT. Can the Senator tell us how many of these plants are contemplated?

Mr. O'MAHONEY. The bill says one or more. The committee did not undertake to put a limitation upon the department, realizing that in every instance the request for appropriations would have to be made to the Bureau of the Budget and then to the Appropriations Committee.

Mr. TAFT. Would different types of coal required different plants?

Mr. O'MAHONEY. No necessarily. I think there ought to be a plant for oil shale, and a separate plant for coal generally. The gradations of coal from lignite through semibituminous, bituminous, and perhaps even anthracite, might make it desirable to have more than one plant for coal, but the committee did not undertake to decide that question.

Mr. McKELLAR. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. McKELLAR. Perhaps the Senator has already answered the question which I am about to ask. What is the relative cost of producing gasoline, say from oil shale and from petroleum?

Mr. O'MAHONEY. The best we can do is to make estimates.

About 2 years ago Mr. William S. Farish, who was president of the Standard Oil Co., of New Jersey, in testifying before the House Committee on Mines and Mining, gave it as his belief that synthetic gasoline would probably cost about 16 cents a gallon. Other estimates are as low as 12 cents a gallon. Of course, that is much higher than the cost of manufacturing gasoline from petroleum.

It is because of the higher cost that private industry has not undertaken the experimental work. For example, much more steel is required to build a hydrogenation plant than is necessary to build an ordinary oil refinery. So there is a higher cost. One of the purposes of the bill, however, is to authorize the Government to undertake the pioneer work to determine to what extent the cost may be reduced.

Mr. DANAHER. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. DANAHER. Did the committee have any evidence as to the minimum period within which the first experimental plant could be constructed and placed in operation?

Mr. O'MAHONEY. I think Dr. Fieldner, the head of the Bureau of Mines, was of the opinion that it probably would be certainly not less than 18 months before the work could actually be begun.

Mr. DANAHER. Mr. President, will the Senator further yield?

Mr. O'MAHONEY. I yield.

Mr. DANAHER. From line 4 on page 1 of the bill, I take it that even any such estimate would be subject to possible limitation because of the critical material situation.

Mr. O'MAHONEY. Oh, yes.

Mr. DANAHER. I thank the Senator. Mr. McKELLAR. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. McKELLAR. The Senator is an expert on these matters.

Mr. O'MAHONEY. The Senator flatters me.

Mr. McKELLAR. I should like to know about the average cost of producing gasoline from petroleum.

Mr. O'MAHONEY. My recollection is that the cost is about 6 cents a gallon.

Mr. McKELLAR. About 6 cents.

Mr. BUSHFIELD. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. BUSHFIELD. I apologize to the distinguished Senator from Wyoming for not having heard all of his address, and I wish to ask for information. Is it the purpose of the pending bill to put the Federal Government in the petroleum-production business, or merely to conduct experiments?

Mr. O'MAHONEY. The purpose is merely to conduct experiments, and the committee amendment, which I hope will be adopted, makes it clear that the purpose is not to invade the field of commercial production at all.

Mr. BUSHFIELD. If the Senator will permit another question, I understand that in England a considerable portion of their petroleum products is produced

in the manner to which reference has here been made. Am I correct in that understanding?

Mr. O'MAHONEY. Yes; the Senator is correct. That is the fact.

Mr. BUSHFIELD. If Great Britain has proved the success of the process, is it necessary for us to go through the experimental stage or period in this country?

Mr. O'MAHONEY. Yes; I think so, because in England they have been working with the original processes which were developed in Germany, and we desire to have the experimentation carried on in order to determine whether or not production costs may be very greatly reduced.

Mr. BUSHFIELD. I thank the Senator.

Mr. McKELLAR. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. McKELLAR. Now comes the most important question of all. How much money will be required to make these experiments? What appropriation does the Senator ask for?

Mr. O'MAHONEY. According to an amendment which was adopted by the Senate when the calendar was last called, the bill would authorize an expenditure of not more than \$30,000,000. But of course, the Senator well knows that all appropriations would have to come through the Bureau of the Budget and through the various committees of Congress.

Mr. AUSTIN. Mr. President, will the Senator yield?

Mr. O'MAHONEY. I yield.

Mr. AUSTIN. I am pleased to hear the answers of the Senator from Wyoming indicating a purpose which I believe he has held for years, not to allow the Government to go into business in competition with, or to the exclusion of, private industries. On many occasions I have heard him state his belief in our American theory of private enterprise, or free economy. I make that observation because the bill seems in one particular to be in a contrary direction to his answers.

I notice that in the amendment reported by the committee it is intended to obtain engineering data for the development of a synthetic liquid-fuel industry available to private industry. However, in another part of the bill—namely, on page 4, in lines 5, 6, and 7—there are words which would work in the opposite direction, because if they became law they would put into the hands of the Secretary of the Interior complete control of private industry whenever it used any of this engineering data which is covered by a patent. The language to which I refer reads as follows:

And to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this act.

I wonder if the Senator has considered those words in reference to his belief, and whether he recognizes in them exactly the opposite of what he believes. They say in effect that this engineering data, the new discoveries which may be patented, shall be available to the citizens of the United States and to the industries

of the United States for the benefit of its people. I ask that as a question.

Mr. O'MAHONEY. Mr. President, I am very happy to answer the distinguished Senator from Vermont.

My feeling, at least—I cannot speak for the committee because the question was not raised in the committee—is that if the Government of the United States should discover any new processes, it should be in at least as good a position as any private owner of a patent right with respect to patents that may be taken out on any discoveries which are made.

Mr. AUSTIN. Is not that statement of the Senator in opposition to his well-known and traditional attitude with respect to patents and other similar subjects?

Mr. O'MAHONEY. I rather doubt it, because the Senator will observe that in the sentence preceding the one from which he has quoted the committee has inserted an amendment which makes clear that the purpose is not to invade private rights. The language to which I refer is as follows:

Any remaining products may be sold at going prices to any purchaser—

And then the amendment reading—through regular commercial channels.

Mr. AUSTIN. Yes, I am familiar with that language. It is entirely inconsistent, as I conceive it, with opening the door of this scientific research to private industry, and making available to private industry the products of the research, because private industry must come on bended knee, and must yield to what the Secretary of the Interior considers to be the appropriate terms upon which the licenses shall be granted. To my mind that is the highest form of control outside of complete exclusion from the field.

Mr. O'MAHONEY. Mr. President, if the Senator will pardon me for interrupting him, I have repeatedly stated my own personal position that there should be no restriction, either public or private, upon the ability of the citizen to develop new industry and to create new jobs. I feel that it would be altogether improper if the Government should undertake to use any patent rights for the purpose of restricting the citizens. So far as I am concerned, if the Senator cares to offer an amendment which will be in harmony with his views upon that point, I shall certainly be very glad to have the Senate adopt it.

Mr. AUSTIN. Mr. President, I thank the Senator. I believed he would take that position if there were real cause for it. I have a suggestion to make. I shall be glad to give the Senator plenty of time in which to go over it and adapt it to his views. It will carry out what I have always believed to be his view, namely, that the door must be kept open to private enterprise for all discoveries in science made at the cost of the United States, or by the agencies of the United States, just as freely as physicians, under their Hippocratic oath, give their special knowledge and skill to all humanity.

Mr. O'MAHONEY. Mr. President, I feel most deeply that we cannot hope to

make the transition from war to peace unless we promote the greatest possible industrial and economic activity on the part of all the people of the United States who desire to engage in enterprise. I feel that the suggestion which the Senator makes is well worthy of consideration.

Mr. AUSTIN. I am very grateful, and I am pleased also to find that I am in accord with the Senator from Wyoming, as I have found myself to be so many times.

Mr. O'MAHONEY. May I suggest to the Senator that the Senate proceed to the consideration of the committee amendments and then take up the suggestion which he cares to make?

Mr. AUSTIN. That would be satisfactory to me if the Senator so prefers. I thought I would first inform him of what was in my mind.

Mr. O'MAHONEY. Very well.

Mr. AUSTIN. If there was to be such an amendment, I was sure the Senator would be glad to consider it, and I wanted to give him all the time which he desired in which to consider it.

Mr. President, I submit the following amendment:

On page 4 of the original print, beginning with the comma in line 1, I propose to strike out all thereafter down to and including line 3, and in lieu thereof insert a period and the following:

No patent or patent rights acquired by the Secretary of the Interior under this act shall prevent any citizen of the United States or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process to which such patent or patent rights relate, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

Mr. O'MAHONEY. I am happy to have had the amendment read to me, and I shall be very glad to examine it.

Mr. AUSTIN. I send the amendment to the desk and ask that it be printed for the information of the Senate.

The PRESIDING OFFICER. Without objection, it is so ordered.

Mr. O'MAHONEY. I ask that the Senate proceed with the consideration of committee amendments.

The PRESIDING OFFICER. The question is on agreeing to the next amendment of the committee, which will be stated.

The next amendment of the Committee on Public Lands and Surveys was, in section 1, page 2, line 5, after the word "act", appearing in the amendment heretofore agreed to, to insert:

The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

Mr. DANAHER. Mr. President, I take it that the first committee amendment is that stated on page 2, from lines 5 to 12, inclusive. Is that correct?

The PRESIDING OFFICER. That is correct.

Mr. DANAHER. Mr. President, one of the interesting things concerning this bill is the fact that there is nothing emergent about it. Representations to the contrary were made to the Senate when the calendar was called some time ago and the bill was objected to, some Senators seeming to think that the war effort would cease overnight if we did not act on the bill on the call of the Unanimous Consent Calendar, while others intimated that the supply of gasoline available for our necessary civilian transport would dry up, so to speak, and no source of petroleum products would be available to us at all unless we passed this bill on the Unanimous Consent Calendar. It appears as the Senator from Wyoming has correctly pointed out, that in the State of Wyoming alone more than 100,000,000 barrels of oil have been made available to the American people simply by reducing the royalty charge to 12½ percent for discoveries or development of petroleum products on Government property on the public lands. Moreover, it becomes apparent, Mr. President, that the supply of oil and gasoline to be derived therefrom stretches, insofar as known deposits are concerned, a very minimum of some 50 years, and that with reference only to supplies in the United States not to mention supplies in other parts of the world. It further becomes apparent from the answer the Senator from Wyoming readily gave to a question asked by me, at the very least the earliest period of time within which one of these experiment plants could be built would be 18 months, and that period would, in turn, depend upon whether or not the critical materials would be available for its construction.

So, Mr. President, whatever else the bill is, whatever else it may hold within its four corners, do not let us act on it on the theory that there is anything emergent about it.

What will it do? Mr. President, perhaps we had best turn for our answer to a report which was submitted by the very distinguished Senator from Wyoming, a portion of which at least appears on page A4702 of the CONGRESSIONAL RECORD Appendix of October 19, 1943. I wish to call the attention of the Senate to two recommendations which are deemed, according to the Senator from Wyoming, most important. I read:

1. There should be set up a central technical authority of the Federal Government. This authority should coordinate the increasing activities of the Government in scientific fields. It should not dictate the methods to be carried out by existing Federal scientific bureaus, but should serve as a clearinghouse for these organizations. It should help their understanding and willingness to work together as a team.

The second of the two recommendations deemed most important by the Senator from Wyoming follows:

2. Every business and institution should have full access to all patents and research findings which have been developed at Government expense. The Congress has provided large sums of money, which are being poured into Federal, university, and industrial laboratories. It is the intention of the

Congress that this money be spent for the benefit of the general public, not for the exclusive benefit of a few corporations. Likewise, those enemy patents seized by the Alien Property Custodian should become the property of the Federal Government and be made available to all businesses. These patents should not be turned over to a few corporations or returned to their former alien ownership. The compensation should eventually be made to Axis nationals under procedures prescribed for all types of seized enemy property.

Mr. President, when the bill first came before the Senate from the committee it provided for the condemnation of patents and secret formulas. It, moreover, provided that the Secretary of the Interior, operating pursuant to the authority of this legislation, could grant to American users "on such terms as he may consider appropriate, licenses under patent rights acquired under this act."

This bill collides head on, and we ought to know it, with everything the Government has always stood for with reference to the rights of individual citizens. If we have come to the time in American history when the United States Government should be made a partner in big business or a partner in a given industry, and should take over the development of processes and secret formulas and the like, and thereafter on terms to be prescribed by some bureaucrat, should make the information available to business, then, it may be that we have the power, it may be that we have the authority, it may be that there is necessity for the act. But let us understand what confronts us. That is what this bill represents. It is the opening wedge by which the people's money, drawn from all the taxpayers, will be utilized by the United States Government to develop certain formulas and certain processes and through the plants to be constructed will manufacture the finished product, make it available to the Army and Navy for their purposes, and thereafter turn over to the public any surplus, should there be any, "through"—and I read from page 4, line 1—"through regular commercial channels."

Then, Mr. President, business becomes merely a purveyor to the general public, business becomes solely a distributor; the Government becomes the producer.

If we are to do this in the case of oil, where do we stop? Why do we take oil? We take oil because we can reach the Senators from Colorado and the Senators from North Dakota and the Senators from Wyoming and the Senators from Texas and the Senators from a sufficient number of other States to get them back of this program. That is why we do it. If that is what we are going to do, Mr. President, then let us understand why we are doing it, and let us understand what the result is going to be in terms of its effect upon the American economy.

Mr. MILLIKIN. Mr. President, will the Senator yield?

The PRESIDING OFFICER (Mr. THOMAS of Oklahoma in the chair). Does the Senator from Connecticut yield to the Senator from Colorado?

Mr. DANAHER. I yield.

Mr. MILLIKIN. I wish to say to the distinguished Senator from Connecticut,

that if I should vote in favor of this bill, my vote will not have been so cast by reason of the process he has mentioned.

Mr. DANAHER. I will say to the Senator from Colorado that I absolve him from any of the stratagems which would involve reaching out to the Senators from the various States. As a matter of fact, it is my firm belief that the Senator from Colorado has never been consulted in the development of any such plan. I believe that the Senator from Colorado does not hold to the philosophy represented by this bill, exhibit A.

What else would we do? We would step in and overthrow the experience of generations of men in public life. Under the bill we would suspend, so far as the Secretary of the Interior is concerned, the provisions of section 3679 of the Revised Statutes. I call attention to page 3, line 18. What does section 3679 of the Revised Statutes provide? It reads:

No executive department or other Government establishment of the United States shall expend, in any one fiscal year, any sum in excess of appropriations made by Congress for that fiscal year, or involve the Government in any contract or other obligation for the future payment of money in excess of such appropriations unless such contract or obligation is authorized by law. Nor shall any department or any officer of the Government accept voluntary service for the Government or employ personal service in excess of that authorized by law, except in cases of sudden emergency involving the loss of human life or the destruction of property. All appropriations made for contingent expenses or other general purposes, except appropriations made in fulfillment of contract obligations expressly authorized by law, or for objects required or authorized by law without reference to the amounts annually appropriated therefor, shall, on or before the beginning of each fiscal year, be so apportioned by monthly or other allotments as to prevent expenditures in one portion of the year which may necessitate deficiency or additional appropriations to complete the service of the fiscal year for which said appropriations are made—

I break off at the semicolon in reading from title 31, section 665, to point out that the moment we make the authorization provided under the bill, and the moment we appropriate "not to exceed \$30,000,000," and then suspend section 3679, we obviously authorize commitments over and above and beyond any appropriation of any maximum authorization, because we would wipe section 3679 from the books by the language of the bill. Why is that kind of power desired?

I resume reading of section 3679 of the Revised Statutes—

And all such apportionments shall be adhered to and shall not be waived or modified except upon the happening of some extraordinary emergency or unusual circumstance which could not be anticipated at the time of making such apportionment, but this provision shall not apply to the contingent appropriations of the Senate or House of Representatives; and in case said apportionments are waived or modified as herein provided, the same shall be waived or modified in writing by the head of such executive department—

And that is Mr. Ickes, in this case— or other Government establishment having control of the expenditure, and the reasons

therefor shall be fully set forth in each particular case and communicated to Congress in connection with estimates for any additional appropriations required on account thereof. Any person violating any provision of this section shall be summarily removed from office and may also be punished by a fine of not less than \$100 or by imprisonment for not less than 1 month.

So it is imperative that we suspend the operations of Revised Statutes, section 3679, insofar as it might constitute a limitation upon operations under the bill. That is why the language is in the bill. Whoever drafted the bill did not insert that by accident. We know enough about the writing and the history of the writing of legislation to know that when the suspension of a statute of that character is suggested, there is a purpose back of it.

What else would the bill do? It would suspend sections 321 and 322 of the act of June 30, 1932, described in the bill as 47 Statutes 412. Section 321 appears as section 278a of title 40, United States Code, and I read it:

After June 30, 1932, no appropriation bill shall be obligated or expended for the rent of any building or part of a building to be occupied for Government purposes at a rental in excess of the per annum rate of 15 percent of the fair market value of the rented premises at date of the lease under which the premises are to be occupied by the Government, nor for alterations, improvements, and repairs of the rented premises in excess of 25 percent of the amount of the rent for the first year of the rental term, or for the rental term if less than 1 year: *Provided*, That the provisions of this section shall not apply to leases made prior to June 30, 1932, except when renewals thereof are made after such date, nor to leases of premises in foreign countries for the foreign services of the United States: *Provided further*, That the provisions of this section as applicable to rentals, shall apply only where the rental to be paid shall exceed \$2,000 per annum.

So the bill would suspend the provisions which would constitute a limitation upon the amount of rent to be paid under section 322, referred to in line 14, page 3, of the bill, which we find appearing as section 303 (b) of title 40, which reads:

Except as otherwise specifically provided by law, the leasing of buildings and properties of the United States shall be for a money consideration only, and there shall not be included in the lease any provision for the alteration, repair, or improvement of such buildings or properties as a part of the consideration for the rental to be paid for the use and occupation of the same. The moneys derived from such rentals shall be deposited and covered into the Treasury as miscellaneous receipts.

Mr. President, having authorized the Secretary of the Interior, acting through the Bureau of Mines, as the bill would do, "to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances"; having authorized the Secretary of the Interior "to conduct laboratory research and development work"; having authorized him "to acquire, by purchase, lease for a term of years, or donation, land and any interest in land, including easements and leasehold interest, options on real or personal property, plants and their facilities, se-

cret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation," we would authorize him also "to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property," to contract for the disposition or development of such properties, including anything that is taken under the authorization of the section, to cooperate with any other Federal agency, and thereafter to sell the product at not more than actual cost, "including amortization of capital expenses," as the Secretary shall decide.

Having done that, having authorized him to grant licenses under the terms of patent rights he may acquire, I submit we will have erected a vast blanket authority, having suspended all the limitations and the prohibitions which the statutes have hitherto granted unto the American people. The Secretary of the Interior, through the Bureau of Mines, will be the spearhead of this development, to which the Senator from Wyoming has quite candidly and forthrightly called our attention in his report.

Mr. O'MAHONEY. Mr. President, will the Senator yield?

Mr. DANAHER. I yield.

Mr. O'MAHONEY. I think the Senator is mistaken in attributing to me the report from which he read.

Mr. DANAHER. The Senator is correct. It was the Senator from West Virginia [Mr. KILGORE] who filed the report. The Senator from Vermont refreshes my recollection on that point, and I thank him for doing so. I will say, if the Senator from Wyoming will permit, that in that particular reference I did confuse his name with that of the Senator from West Virginia, but I was not unmindful of the bill which the Senator from Wyoming introduced, and which was referred to the Committee on Patents last year, which would have accomplished substantially the same result. The philosophy of the report of the Senator from West Virginia and the statement made by the Senator from Wyoming before the Committee on Patents are quite similar, I will put it.

Mr. O'MAHONEY rose.

Mr. DANAHER. I am willing to have the Senator from Wyoming, who is present, dissociate himself from that if he chooses.

Mr. O'MAHONEY. Mr. President, I think the Senator from Connecticut is drawing a little on his imagination when he says that the bill which I introduced with the Senator from Wisconsin [Mr. LA FOLLETTE] and the Senator from Washington [Mr. BONE], and which went to the Committee on Patents, is similar to the measure which was sponsored by the Senator from West Virginia. The purpose of the former measure was to prevent the use of a right, granted by the Congress of the United States, by international cartels and domestic monopolies, to restrain the activities of the people of America.

Mr. DANAHER. I thank the Senator from Wyoming and I am glad to have

him afforded the opportunity to make that statement.

Mr. President, whatever may be the effect, let me put it, of the bill introduced by the Senator from Wyoming, and the philosophy back of the measures to which I advert, what concerns us is the trend and direction which will be taken should the pending bill become law, the ultimate of which will be to put our Government necessarily and inevitably in the position of conducting explorations, scientific investigations, and development of properties at Government cost, and thereafter their allocation and use under governmental aegis. That, Mr. President, is what I wish to have the Senate recognize as inherent in the objectives of the bill. It is because of these points, and the views which I hold with respect to the general subject, that I feel the Senate should be put on notice, and it is to that purpose, Mr. President, that I rise before the Senate even considers the committee amendments.

The PRESIDING OFFICER. The clerk will state the first of the committee amendments not heretofore agreed to.

The LEGISLATIVE CLERK. On page 2, line 1 of the original committee print, it is proposed to insert the following:

The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

The PRESIDING OFFICER. Without objection, the amendment is agreed to.

The clerk will state the next committee amendment.

The CHIEF CLERK. On page 1, line 15 of the original committee print, before the word "donation", it is proposed to insert the word "or."

The PRESIDING OFFICER. Without objection, the amendment is agreed to.

The clerk will state the next committee amendment.

The CHIEF CLERK. In the same line it is proposed to strike out the words "or otherwise."

The PRESIDING OFFICER. Without objection, the amendment is agreed to.

Mr. DANAHER. Mr. President, I thought I heard the clerk say page 1, line 15.

The PRESIDING OFFICER. The Chair will state that the bill from which the clerk is now reading contains a different text from that on the desks of Senators.

Mr. DANAHER. It certainly does, Mr. President, because we have just agreed to an amendment which apparently is very much at odds with the version on our desks. Mr. President, may we have the amendment stated in full, instead of simply saying page so and so and line so and so.

The PRESIDING OFFICER. The next committee amendment will be stated.

The CHIEF CLERK. On page 3, line 22 of the original committee print, after the word "purchaser", it is proposed to insert "through regular commercial channels."

Mr. LODGE. Mr. President, that does not correspond with the print I have.

Mr. GURNEY. Mr. President, I should like to have the clerk have before him and read from the same bill which has been printed since the bill went partially through the legislative process on the call of the calendar some time ago. We have a new print before us today.

The PRESIDING OFFICER. The Chair is advised that the Senate must work from the original bill. The clerk will state the pending committee amendment.

The CHIEF CLERK. On page 3, line 22, of the original bill, after the word "purchaser" it is proposed to insert "through regular commercial channels."

Mr. LODGE. Mr. President, what is the corresponding place in the bill on the desks of Senators?

Mr. GURNEY. Mr. President, if the Senator will yield I will say to him that the language will be found on page 4, line 1.

The PRESIDING OFFICER. On page 4, line 1, of the reprint will be found the amendment which has just been stated.

The question is on agreeing to the committee amendment.

The amendment was agreed to.

The PRESIDING OFFICER. That concludes the committee amendments.

Mr. GURNEY. Mr. President, as a member of the subcommittee of which the senior Senator from Wyoming [Mr. O'MAHONEY] is the chairman, I have taken much interest in the bill. I have taken an interest in it primarily because I know that the whole economy of our Government is built on the basis of whether or not sufficient fuel is in storage or in our view in the immediate future so that the internal-combustion engine may be continued in use by the citizens of the United States. I do not say gasoline, I do not say acetylene or gas made from charcoal or something else, but I do say fuel used in an internal-combustion engine, and at the moment our economy is built on the use of gasoline. Gasoline made from coal is gasoline similar to that we are now using.

Mr. President, our committee held hearings covering a period of several weeks, and I should like to bring out a few points which I do not believe have been brought out so far.

First, I believe that the evidence was conclusive that our supply of known oil resources inside the continental limits of the United States is being rapidly used up. While the proof submitted was not definite, though two or three statements were made as to the detailed oil resources in the United States, it was quite generally conceded that at our present rate of consumption there is between 14 and, say, 20 years' supply of oil in the ground, and that it would take approximately 50 years to pump or have flow from the ground that 14 or 20 years' supply. If we pump it too fast, as we may be compelled to do in wartime, the supply will not last as long as if we pump it in rea-

sonable amounts as we do in connection with our peacetime economy.

The finding of another resource from which to obtain motor fuel will, of course, cost an immense amount of money. There has been some apprehension among Members of the Senate that with the \$30,000,000 provided in the bill we will be able to set up a Government industry which could compete with private industry in the production of motor fuel. I do not think there is a possible chance of that. The evidence was that one refinery such as is now in operation at Bellingham, England, costs between \$28,000,000 and \$30,000,000. That refinery is at present producing, and is only capable of producing, 20 carloads of aviation or motor fuel gasoline a day. I think the exact capacity of the plant is 3,500 barrels, which would be about 15,000 gallons of gasoline a day.

So with the amount of money provided in the bill there is no danger of setting up a competitive industry in the United States. In fact, using the cost of the hydrogenation plant in England as a basis and figuring the output of the plant, it has been estimated that the number of plants necessary in the United States to produce our present requirements of gasoline would cost in excess of \$50,000,000,000. Other estimates have been made which might reduce the initial cost of constructing the plants necessary to supply our requirements to \$25,000,000,000, using the facts, the processes, and the knowledge now available for making motor fuel from coal.

As I see it, Mr. President, it is very necessary for us to try to find new processes—new ways—to obtain motor fuel from coal. I have a suggestion to make with reference to how we should proceed to acquire this sorely needed information, but I wish to say that in our hearings held in various cities in the United States industry—and by that I mean the oil industry—was given the chance, and accepted the chance, to be present and give us its recommendations as to what should be done in seeking further knowledge on the subject of making gasoline from coal.

Without exception, during the hearings, industry did recommend that the Government undertake the laboratory work, the pilot-plant work, the semi-work-plant work, and finally go into the matter of building a demonstration plant sufficiently large so that the commercial possibilities could be fully demonstrated.

Since the hearings have ended, I have taken the opportunity to inquire further into the desires of industry. My conclusions are that even though petroleum companies in the United States are large, nevertheless, none of them are sufficiently large to undertake from the standpoint of expense the laboratory and experimental work necessary to be done in order to obtain motor fuel from coal. The program is a long-time one. I believe the Government should make every finding resulting from its experiments quickly available to private industry in the United States. I think that Government—by that, I mean the Bureau of Mines, as is stated in the bill—should start at the bottom.

So at this time I offer an amendment which would be, according to the original print, the one from which the reading clerk read some few minutes ago, on page 2, in line 12, after the word "work." According to the print which is now before us, the latest print, it would come on page 2, in line 16, after the word "work." I send the proposed amendment to the desk, and ask that it be stated.

The PRESIDING OFFICER. The amendment will be stated.

The CHIEF CLERK. In the original print of the bill, on page 2, line 12, after the word "work", it is proposed to insert "and with pilot plants and semi-work plants make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs."

Mr. GURNEY. Mr. President, subsection (a) of section 2 of the bill then would read:

(a) To conduct laboratory research and development work and with pilot plants and semiwork plants make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs necessary to determine the best demonstration plant designs and conditions of operation.

Mr. LODGE. Mr. President, will the Senator yield?

Mr. GURNEY. I yield.

Mr. LODGE. I am very much interested in this matter. I tried to express my interest in it in June, in a speech I made at that time, because of the tremendous importance of oil to our whole civilization and our position in the world.

As I understand the matter, there are two great sources of natural oil in the world, broadly speaking: One, the Caribbean basin, running from Louisiana and Texas down through Venezuela; and the other, the middle-eastern basin, including Iran, Iraq, Saudi Arabia, and Russia.

Before the war there was a policy, which I shall not discuss, of drawing from the Caribbean basin a great deal more oil than was drawn from the middle-eastern basin, proportionately. The facts which are now available to us lead me to the conclusion that with the oil we have in the United States at the present time, or which we think we have underground, it would be impossible for us, to support another major war on the scale of the present one.

So I am naturally sympathetic to anything which looks toward increasing and enlarging our sources of oil.

The question I desire to direct to the Senator is this: In our efforts to build up and to strengthen our oil position, it seems to me some very serious thought will have to be given to the matter of getting oil in the Middle East and bringing it over here, for storage here either in tanks or below ground. While I welcome the Senator's approach to the question, I hope that he and the other sponsors of the bill do not regard the bill as a substitute for or as excluding the proposition of bringing oil from other parts of the world to this country, and storing it here.

Mr. GURNEY. Of course, Mr. President, I cannot answer for the other mem-

bers of the committee, but I personally do not so regard the bill.

Let me say that the peacetime imports of oil into the United States will depend on whether we can produce oil from the sources we have at a lower cost than the cost of imported oil. Certainly, in my opinion, we should do everything we can do to find supplies within the continental limits of our own land. That is the basis on which I have approached consideration of the bill.

Mr. REVERCOMB. Mr. President, will the Senator yield?

Mr. GURNEY. I yield to the Senator from West Virginia.

Mr. REVERCOMB. Am I to understand that the proposed work is solely an experiment, to be undertaken at the cost of the Government, to find some way of producing engine fuel from coal?

Mr. GURNEY. I should say it is not an experiment. We already know that gasoline is being produced in Germany and in England from coal. The purpose of the bill is to find out if we can improve upon the present known method, or whether we can find a new method, of extracting gasoline or making gasoline from coal, so that the cost will not be so great as is presently indicated by the known knowledge of the art of making gasoline from coal.

Mr. REVERCOMB. Then, Mr. President, am I to understand that what the bill proposes is still an experiment to determine some advanced or improved method of obtaining fuel?

Mr. GURNEY. That is correct.

Mr. REVERCOMB. In other words, it is not an attempt by the Government to go into the business of producing gasoline, is it?

Mr. GURNEY. Not as I see it.

Mr. REVERCOMB. If, as the Senator has said, there is already established, and has been for some time, such an operation in the British Isles, would not the data the British have be available to the private enterprises of America?

Mr. GURNEY. The evidence is quite clear that those data are now available not only to private enterprise in the United States but also to the Government, and that they are in the possession of the Government.

Mr. REVERCOMB. Then, if we are endeavoring to ascertain some formula or improved method, would not the work proposed to be done under the bill be a duplication of the effort made in the British Isles?

Mr. GURNEY. There would be absolutely no necessity for the bill if we were willing to take the facts, figures, and operating data now possessed by the British. What we must do is improve on those methods. That is what the bill intends. Its purpose is to give the scientists and engineers a chance to discover better methods.

Mr. REVERCOMB. The bill proposes that an experiment be conducted in an endeavor to improve the method of obtaining fuel from coal. I desire to ask the Senator one further question. Under the very broad power given under subsection (b) of section 2 "to acquire, by purchase, lease, or donation, land"

why is not some limitation placed upon the amount of land which may be acquired for this purpose?

Mr. GURNEY. I am sure a limitation is provided by the specification of \$30,000,000 at the beginning of the bill. Also, a little later in the bill the Senator will notice that the experiments under the bill may not continue for longer than 5 years.

Mr. WHERRY. Mr. President, will the Senator yield?

Mr. GURNEY. I am glad to yield to the Senator from Nebraska.

Mr. WHERRY. Granting that for experimental purposes the bill should be passed, I desire to ask the Senator whether he feels he can justify the proposed expenditure at this time, or upon what basis he justifies the proposed expenditure?

Mr. GURNEY. Personally I justify the passage of the bill, and the appropriation needed, upon the fact that our whole economy is built upon having a sufficient supply of gasoline for automobiles, for internal-combustion engines in industry, for airplanes, and for many other purposes, in addition to the further fact that our known supply of petroleum reserves is rapidly dwindling. We must do everything to learn better how to obtain gasoline from any source available, including not only coal and oil shale, but also oil sands inside the continental United States.

Mr. WHERRY. Does the Senator feel that we could accomplish that purpose better by the passage of this bill than by exploring our known oil fields, which are not being explored today?

Mr. GURNEY. I want to do this, and to do that in addition. Everything must be done to increase our known reserves of oil.

Mr. WHERRY. I agree with the Senator. I think his statement is correct.

Mr. GURNEY. We must not miss a bet.

Mr. WHERRY. I agree with the Senator; but this is the situation in which we find ourselves in the United States: The Secretary of the Interior has recommended an increase of 35 cents a barrel for the production of crude oil. Thousands of stripper wells would go into production if the producers could get an increase of 35 cents a barrel. Thousands of oil operators would explore new fields and known fields to bring in more oil at the present time if they were given a profitable basis upon which to operate. That could be done by an increase of 35 cents a barrel in the price of crude oil.

Mr. GURNEY. I agree entirely with the Senator. I have written to the O. P. A., the W. P. B., the Secretary of the Interior, and many other Government agencies heartily endorsing Secretary Ickes' request for an increase of 35 cents a barrel.

Mr. WHERRY. The Price Administrator has turned down the request. We are to have no new exploration for oil. For that reason we are still groping for more fuel. We are being rationed, and are working on the theory of a scarcity. The supply does not meet the demand. If we are to get oil, and get it imme-

diately, we can justify the expenditure involved in an increase of approximately 35 cents a barrel, which is approximately equivalent to one-half cent a gallon at retail, and get an immediate supply for immediate use, rather than to spend \$35,000,000, which is about one-tenth of the entire increase in cost which would be involved if the recommendation of the Secretary of the Interior were approved by the Economic Stabilizer.

Mr. GUFFEY. Mr. President, will the Senator yield for a question?

Mr. WHERRY. I yield.

Mr. GURNEY. Mr. President, I have the floor.

Mr. GUFFEY. The Senator from Nebraska knows that more wildcat oil wells have been drilled this year than in any other year in our history.

Mr. WHERRY. In answer to the Senator's suggestion, let me state that the testimony in five hearings shows that there has been less exploration this year than in any past year, and that oil operators are stating that if they do not get an increase in price, there will be no new exploration for the year 1944.

Mr. GUFFEY. Will the Senator deny that more wildcat wells were drilled this year than in any other year in our history?

Mr. WHERRY. In five hearings, which were held in Kansas City, Chicago, Pittsburgh, Oklahoma City, and Washington, the oil operators stated that unless there is an increase of 35 cents a barrel in crude-oil prices, there will be practically no new exploration at all.

Mr. GUFFEY. The Senator has not answered my question.

Mr. WHERRY. I think I have answered it.

Mr. GUFFEY. I do not think the Senator has answered my question.

Mr. GURNEY. Mr. President, I believe that this colloquy is entirely foreign to the purposes of the bill. The bill is an endeavor on the part of the subcommittee to start the process rolling so that in the future we will know more about how to get a larger supply of motor fuel. I hope the senior Senator from Wyoming has considered my amendment and has found it acceptable.

Mr. O'MAHONEY. Mr. President, the Senator from South Dakota called this amendment to the attention of the chairman of the subcommittee. It has been discussed with other members of the committee, and on behalf of the Committee on Public Lands and Surveys, I am very happy to accept the amendment.

The PRESIDING OFFICER. The question is on agreeing to the amendment offered by the Senator from South Dakota [Mr. GURNEY].

The amendment was agreed to.

Mr. McKELLAR and Mr. AUSTIN addressed the Chair.

The PRESIDING OFFICER. The Senator from Tennessee is recognized.

Mr. McKELLAR. Mr. President, I believe we are about to have a vote on the bill.

Mr. AUSTIN. Mr. President, I have an amendment to offer.

Mr. McKELLAR. I yield for that purpose.

Mr. AUSTIN. I now offer the amendment which I called to the attention of the Senate awhile ago, and ask that it be stated.

The PRESIDING OFFICER. The amendment offered by the Senator from Vermont will be stated.

The CHIEF CLERK. On page 4, line 1, in the original text, and line 5 of the reprint, after the word "act", it is proposed to strike out "and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this act" and insert "No patent or patent rights acquired by the Secretary of the Interior under this act shall prevent any citizen of the United States, or corporation created under the laws of the United States, or any State thereof, from using any invention, discovery, or process to which such patents or patent rights relate, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use."

Mr. O'MAHONEY. Mr. President, I should like to ask the Senator from Vermont if it is his opinion that the amendment which he has now offered would have the effect of authorizing any corporation to use a patent or a device developed by the United States for any monopolistic purpose.

Mr. AUSTIN. No.

Mr. O'MAHONEY. Does the Senator believe that his amendment would render legal the utilization by any corporation of such patent in any international cartel?

Mr. AUSTIN. No.

Mr. O'MAHONEY. Then the purpose of the Senator in offering this amendment is solely and exclusively to make available to the people of the United States and the corporations of the United States the discoveries which may be made by reason of this expenditure of public funds?

Mr. AUSTIN. I will have to answer that question "No" and make an explanation. It is not my purpose to bar the exclusive ownership and control of patent rights by the United States as against foreign countries and their representatives; but it is my purpose to prevent that limitation existing as against any citizen of the United States or any corporation organized and existing under the United States or any State of the Union.

Mr. O'MAHONEY. Is the Senator satisfied that the language which he has proposed is likely to accomplish the purpose which he has described?

Mr. AUSTIN. I have consulted the legislative draftsman, and this represents his judgment. So far as I have been able to give it study, I am satisfied with it, although I must admit that the amendment has been drafted very hurriedly, within the past hour.

Mr. O'MAHONEY. Under the circumstances, on behalf of the committee, I am glad to accept the amendment.

The PRESIDING OFFICER. The question is on agreeing to the amendment offered by the Senator from Vermont [Mr. AUSTIN].

The amendment was agreed to.

Mr. MURDOCK. Mr. President, for the past two and a half years I have served as a member of the subcommittee of the Senate Committee on Public Lands and Surveys under the chairmanship of the distinguished senior Senator from Wyoming [Mr. O'MAHONEY]. First I wish to compliment him in the highest terms for the manner in which he has conducted not only the hearings on the pending bill but all hearings which have been conducted by the committee. In my opinion for industry and his statesmanlike approach to the crucial question involved in the pending bill he should be complimented, and be given a vote of thanks, not only by the Congress but by the people of the United States, for the contributions which he has made by the hearings he has conducted and by the legislation which he has introduced in support of the oil and related industries of the Nation.

Just before the close of the last session of Congress a bill was passed of which the Senator from Wyoming was the author, which in my opinion has greatly stimulated wildcat operations on our public lands and resulted in numerous new discoveries of petroleum in the United States. The bill which we now have under consideration, in my opinion, is not untimely; it is not inopportune; but is very timely. Certainly when we look at the exhibits which have been submitted today by the senior Senator from Wyoming, indicating what is happening to the petroleum reserves within this country, it is high time to give consideration to such a bill as we have before us today.

All we have to do is to look at the diagram immediately in front of me, wherein is shown the density of drilling operations in the United States as compared with the rest of the world, to get the answer to the exploitation of our oil reserves compared to that of other countries.

In looking at the other maps we find that the potential petroleum reserves of the world outside the United States are gigantic, and that when our reserves have been exploited to the degree to which they have been exploited, in all probability we can expect, after the cessation of hostilities in the present war, to see other countries advance and move ahead of the United States in the production of petroleum.

The pending bill does not provide for something new in the way of experimentation. The bill merely provides that the United States shall interest itself in finding out and carrying on the best processes in the development and utilization of the two greatest sources of synthetic liquid fuels in the United States today, those sources being the coal reserves of the United States and the great oil-shale reserves of the States of Wyoming, Colorado, and Utah.

Referring to coal for a moment or two, we find that the coal reserves of the States of Colorado, Wyoming, and Utah are not measured in millions of tons or billions of tons, but in trillions of tons. So the coal reserves of Utah, Wyoming, and Colorado, as well as the lignite deposits of the Dakotas, are the greatest potential source of synthetic liquid fuels in the United States today.

A few moments ago the distinguished Senator from Nebraska [Mr. WHERRY] stated that if we should raise the price of crude oil we could greatly stimulate wildcat drilling of petroleum wells in the United States. I thoroughly agree with that contention. I have requested, as vigorously as it has been in my power to do so, that an increase in the price of crude petroleum be granted. For some reason or other it has not been granted up to this time. But we do not have to do any wildcat drilling; we do not have to do any drilling at all in the Western States which I have mentioned to find millions of acres—or, if we want to put it in terms of tons—billions of tons of oil shale.

Every ton of oil shale in those three Western States is capable of producing approximately 35 gallons of oil. We do not have to worry about drilling wells in order to avail ourselves of that source of oil. We do not have to do a great deal of experimenting now, because between the years 1913 and 1926 the country did experimental work and research work as well as investigation, to the point that if we want to look at the testimony in these hearings of a very distinguished engineer, L. C. Karrick, of Salt Lake City, we will find that he takes the position that today oil and gasoline can be produced as cheaply from the coals of Utah, Wyoming, and Colorado, and from the oil shales, as it can be produced from natural oil wells and delivered to the markets of those States.

Mr. President, some may say that that is an exaggeration; but, whether or not it is an exaggeration, it is backed up by years of research and experimentation, not only experimentation with a pilot plant, but experimentation with a commercial sized plant shipped to this country from Scotland, which was in operation in western Colorado for several years demonstrating the commercial feasibility of producing oil from the easily accessible oil shales of Colorado, Wyoming, and Utah.

We have been told that the consumption of oil in the United States today has at last exceeded the new discoveries of petroleum. We have been told that a great amount of the gasoline and fuel oil which Germany is now using in carrying on the war against us comes from the very processes which are intended to be investigated under the pending bill. We are told that in England a great plant is in operation utilizing these processes in the production of gasoline from coal, and that in other parts of the British Empire plants are in operation producing oil from oil shale.

All that the bill proposes is to authorize the appropriation of \$30,000,000—to do what? To determine here in the United States what are the cheapest and most economical processes for producing synthetic liquid fuels from the greatest sources of oil and synthetic fuel within the United States. Is that not a rather small amount of money for this country to expend in order to be fully informed as to the utilization of those great natural resources in the production of synthetic liquid fuels, which in case of a long war

may become very necessary in achieving victory in a military way, and which will be such a great and important factor in the economy of this country once hostilities cease?

Mr. BUSHFIELD. Mr. President, will the Senator yield?

Mr. MURDOCK. I yield.

Mr. BUSHFIELD. The distinguished Senator spoke a moment ago about what the pending bill provides. I notice in section 2, on page 2, line 13, the following language:

In order to carry out the purpose of this act, the Secretary of the Interior is authorized—

To do certain things. I call the Senator's attention to subsection (b) of section 2 on that page, in which occurs the following language:

to acquire, by purchase, lease for a term of years or less, or donation, land and any interest in land, including easements and leasehold interests; options on real or personal property.

I am asking for information. Does the Senator interpret that section to mean that the Secretary of the Interior may start out on a condemnation spree and take land holdings away from private owners?

Mr. MURDOCK. I think the able Senator is capable of interpreting the language to which he has referred with ability equal to that of the Senator from Utah. In my opinion that is a stock provision in the bill so as to remove any handicaps or anything which might impede or in any way inconvenience the Secretary of the Interior in going ahead under this bill. I do not believe the Secretary of the Interior will have to acquire a great deal of land. I do not think he will have to acquire a great deal of personal property or any other kind of property. Millions of acres of public lands containing oil shale in the three States which I have mentioned are awaiting development by the Government.

Mr. O'MAHONEY. Mr. President, will the Senator yield?

Mr. MURDOCK. I yield.

Mr. O'MAHONEY. I desire to invite the attention of the Senator from South Dakota to the fact that an amendment has already been adopted striking out the words "or otherwise", which would remove the right of condemnation. As the bill now stands, it would merely authorize the Secretary of the Interior to acquire land by purchase, lease, or donation. The words "or otherwise" were eliminated precisely for the purpose of making it clear that it was not the intention of the Committee on Public Lands and Surveys to authorize the Department of the Interior to condemn land unnecessarily.

Mr. BUSHFIELD. Mr. President, will the Senator from Utah further yield?

Mr. MURDOCK. I yield to the Senator from South Dakota.

Mr. BUSHFIELD. I am seeking information. I inquire if it is the interpretation of the Senator from Wyoming that there is no power of condemnation under this provision.

Mr. O'MAHONEY. There is no such power. The bill has been amended so as to make that clear.

Mr. MURDOCK. Mr. President, I was not advised of the amendment of which the Senator from Wyoming speaks, but, even if there were the power of condemnation on the part of the Secretary of the Interior to carry out the purposes of this bill, so far as the Senator of Utah is concerned, I could see no particular danger in that. I have full confidence in the ability, integrity, honesty, and judgment of the present Secretary of the Interior. What we want to do by the enactment of this bill is to place the United States of America abreast of England, Japan, and Germany and all other countries in the production of synthetic liquid fuels. I do not think that today conditions affecting the production and discovery of petroleum in the United States have reached such a point that we need to be alarmed; but I do believe they have reached such a state as to make it prudent on our part, as a great Government, a Government that wants to be in the forefront not only on this question but on all others, to be looking into these great sources of oil and of gasoline, so that, if and when, the time ever comes when the future petroleum supply of this country shall have been dangerously depleted we shall be able to pick up from there and proceed with the production of synthetic gasoline and other fuels from our vast resources of oil-shale and coal.

Mr. MALONEY. Mr. President, will the Senator yield?

Mr. MURDOCK. I yield to the Senator from Connecticut.

Mr. MALONEY. I have been called from the Chamber and may not be able to return before the close of today's session; so I should like to have a moment of the Senator's time to join him in the compliment he has paid to the chairman of the committee and to add my compliment to the members of the committee for this very worth-while undertaking. As a member and chairman of the oil shortage committee of the Senate I have long been concerned with this question, and I think the contribution here made toward our future needs cannot be adequately visualized at the moment.

Fearful that the debate would be concluded before I returned, because I doubt if there is now any opposition to the bill, I wanted to make this brief statement and to tell the Senator that I share the views he has so eloquently expressed as to the importance of the legislation and the undertaking to develop synthetic sources for liquid fuels. I thank the Senator.

Mr. MURDOCK. I thank the Senator for his contribution.

Mr. President, I do not desire to hold the Senate longer; I think we are ready to vote on the bill, and I doubt if there will be any votes in opposition to it.

When we held our hearings in Pittsburgh, Salt Lake City, and Sheridan, Wyo., we were advised by State officials of West Virginia, Pennsylvania, Illinois, Utah, Colorado, and Wyoming that they stood ready to cooperate in every way

possible to make the projected plants a reality and to start on this great work of investigation and experimentation.

I shall conclude, Mr. President, by saying that I do not believe that any hearings were ever conducted by the Senate of the United States or by a committee of the Senate that went more thoroughly into the questions involved than did the hearings and investigation conducted by the subcommittee in this instance. We went into the principal coal-producing States; we went into the principal oil-shale-producing States; wherever we went we were welcomed, and, as I have just said, were pledged the cooperation of the State governments in effectuating this great project. From the beginning of the hearings to the end, as I recall, no witness appeared before our committee in opposition to the purposes of the bill.

I hope, Mr. President, that the bill will be passed by the Senate this afternoon; that it will receive speedy action in the other House; that in the not too distant future the plants, the research work, and the experimentation provided for in the measure will be a reality; that the United States of America, instead of being behind in this great program, will be out in front; and that the great resources which today lie dormant, especially the oil shales of the Western States for which there is no other use, will be utilized by the development of processes which will cause such resources to become great national assets.

Mr. McCLELLAN and Mr. DAVIS addressed the Chair.

The PRESIDING OFFICER. The Senator from Arkansas gave notice early this afternoon that he desired the floor. He has been requesting recognition for some time. The Chair recognizes the Senator from Arkansas.

ARKANSAS AND WHITE RIVERS—FLOOD CONTROL AND NAVIGATION IMPROVEMENTS

Mr. McCLELLAN. Mr. President, early in the session today I introduced a bill to provide for the construction, maintenance, and operation of flood control and navigation improvements, including dams, reservoirs, and allied structures, in the basins of the Arkansas and White Rivers, and for the disposition of surplus electric energy generated by the Federal flood control and navigation improvements in the basins of such rivers. I desire to discuss the provisions of the bill briefly. I shall not take the time of the Senate now to go into all the details and ramifications of what I think it will accomplish.

The Secretary of War, through the United States Corps of Engineers, has heretofore prepared a comprehensive plan for flood control and for the improvement of navigation on the White and Arkansas Rivers. This plan provides for dams, reservoirs, levees, and floodways on these streams and their tributaries. The plan embraces projects in Kansas, Missouri, Oklahoma, Colorado, New Mexico, and Arkansas. Each of these projects or improvements is an essential element in an effective, scientific system of water control and utilization

of water resources in these basins. A very substantial number of these projects have already been authorized by the Congress in the various flood control and river and harbor acts. A few of those within the general plan and previously authorized have already been completed. Some others are in course of construction. On most of those in course of construction, work has been suspended for the duration of the war.

One of the objectives of the bill which I have introduced today is to assure the construction of these various projects—all of them as quickly as possible—having regard, of course, for the needs of the war program. It is of great importance, however, that this general plan in these valleys be effectuated and the construction of all pertinent projects be undertaken and completed with all possible speed and dispatch as soon as this can be done.

The rampaging flood waters which last May turned the fertile fields of these valleys into murky lakes, and carrying in their wake the loss of a large number of human lives and destruction and devastation of property to the extent of many millions of dollars, testified with far more dramatic emphasis and force than any words I can utter to the need for the consummation of this comprehensive flood-control program in these valleys. That it is primarily the responsibility of the Federal Government to do this job is no longer challenged or seriously disputed. The water resources of this Nation, when properly harnessed and utilized, will convert any attending present liability into a tremendous national asset of perpetual benefits that will substantially enhance and increase our national wealth.

Further procrastination and delay in dealing effectively with the problem of our national water resources is an unwise policy. It would be unsound economically, and should not be indulged in or tolerated by the Congress.

In the post-war period of readjustment and reconstruction, and particularly during the period of demobilization and rehabilitation into peacetime pursuits of those now serving in our armed forces, jobs will necessarily have to be found or provided for many millions of our citizens. Peacetime employment for our returning soldiers and for those who are now working in war industries, who will have to shift back to peacetime enterprises in the post-war era, poses a tremendous economic problem. It is a problem that cannot be solved by the Federal Government alone. Likewise, it is not likely that private industry by itself will be able to provide adequate opportunities for employment. It is anticipated, therefore, that the Federal Government will, for a time at least, have to supplement any rehabilitation program in the post-war period by providing employment for a large number of people. It is hoped, however, that our Government will not have to resort again to a W. P. A. made-work program of the character of that inaugurated and pursued during the years of our economic depression.

For that reason, much has been said—more said than done—about post-war

awaiting fuller development. Much has been done, true, but much more remains to be done.

Yet, to our credit let it be said that years of surveys and studies by the Corps of Engineers, the Bureau of Reclamation and other agencies, Federal and State, have resulted in the accumulation in factual reports of more detailed information than is available to any nation in the world on its respective water resources.

Since Congress in January 1927, authorized and directed the Secretary of War to make surveys of the navigable rivers of the United States and their tributaries, with a view to their most effective improvement for flood control, navigation, irrigation and the development of power, reports have been prepared by my Department on more than 200 rivers. And continuing reviews, in strict compliance with congressional directives, have kept these reports up to date.

On the program of the Corps of Engineers, as established by Congress, the Western States are well represented in authorization, planning, and in construction of projects for flood control and multiple-purpose utilization of water.

Included in the existing authorizations are:

A comprehensive plan of reservoirs and channel improvements for the development of the Willamette River Basin in Oregon for flood control, navigation, conservation, stream-flow regulation, hydro-electric power, and other beneficial water uses;

A series of levees along the Columbia River and its tributaries in Washington and Oregon for the protection of valuable agricultural areas;

A comprehensive system of retarding basins, and channel improvements for flood protection of the metropolitan area of Los Angeles County, Calif.;

A system of flood control reservoirs in the Santa Ana River and adjacent areas for the protection of Orange County, Calif.;

A system of levees, bypasses and channel improvements in the lower Sacramento River Basin, Calif., for the protection of the highly productive agricultural lands and important transportation facilities in that area; and this system is carefully coordinated with the great Shasta Dam.

Comprehensive plans for reservoirs and protective works for flood control, water conservation, power, and other uses in the Missouri, Arkansas, and Red River systems;

And reservoirs on Cherry Creek, Colo., for the protection of the city of Denver and for water conservation. That's quite a project, too. I saw the sites yesterday, and I sincerely hope to see structures in the area in the not too distant future.

Of this extensive program the Army engineers have already completed 10 dams, levees at more than 50 localities, and about 55 miles of improved channels. And we will continue that program to completion as soon as world conditions permit.

In accordance with authorization by Congress, the Corps of Engineers is also making examinations and surveys of most of the large river basins and many of the smaller basins throughout the Western States.

Advance planning activities include studies of such important basins as those of the Gila River in Arizona and New Mexico; streams draining into the Great Salt Basin in Utah and Nevada; the Sacramento and San Joaquin Rivers, Calif., the Santa Ana River, Calif.; the Rio Grande in New Mexico; the Snake River in Oregon and Idaho; and the Columbia River in Oregon and Washington. These surveys are being carefully correlated with the other agencies authorized to deal with the use of water in this great part of our country.

At this point on behalf of the Chief of Engineers and of the Corps of Engineers I should like to express the sincere appreciation for

the splendid cooperation of the Bureau of Reclamation in our studies of the great western area. I am sure that this cooperation will improve and increase as we go along and both of us learn more about our respective fields of endeavor.

As division engineer of the Missouri River division, I have a particular interest in the comprehensive plan for the Development of the vast region of the Missouri Valley as conceived and prepared by my predecessor, Co. Lewis A. Pick.

That plan, designed to conquer drought and flood, the age-old enemies of man, in that area of over half a million square miles, provides direct benefits and additional opportunities for eleven and a half million people, and creates new national wealth for everyone to share. The report was submitted to the Chief of Engineers in Washington early in August of this year. It is now receiving the final review of the other Federal agencies responsible for various phases of water development under existing law, prior to its transmission to Congress.

The Missouri River Valley is one of the very few major basins of this country where comprehensive development and water utilization have progressed little beyond the planning stage. Yet, I know of no comparable area where money wisely spent can bring more commensurate returns in the greatest good for the greatest number.

In the upper reaches of the Missouri and its tributaries, a decade of drought during the thirties destroyed crops and livestock, and decreased populations.

In the lower reaches of the river, especially from Sioux City, Iowa, to the confluence with the Mississippi just above St. Louis, there are many thousands of acres subject to inundation by major floods. Much of this land is the most fertile and productive in the world.

This year, no section of the 2,500-mile Missouri escaped the curse of floods. Beginning in March and extending until late in June, three disastrous waves of water inflicted tragic hardships on the people and worked incalculable damage to commercial and industrial activities directly connected with the war effort.

A million acres were flooded along the main stem of the Missouri, and an additional million were inundated on the tributaries. Tons and tons of potential food for our soldiers, ourselves, and our allies were destroyed. Rail, air, and highway transportation needed to speed vital war matériel were disrupted. Factory production was impeded. Direct and calculable damages caused by these floods in this year alone on the main stem and tributaries are now estimated to total \$50,000,000.

Such recurring material losses and human hardships can and must be stopped. It is engineeringly feasible and economically necessary.

Briefly, the report of the Corps of Engineers on the over-all development of the Missouri River proposes the completion—as soon as existing and necessary limitations on public works are lifted—of the presently authorized reservoirs in Nebraska, Kansas, and Missouri, and the construction of additional reservoirs, including a series of multiple-purpose dams in the upper river and on its major tributaries above Sioux City, Iowa. It proposes also a series of levees and appurtenant works along the main stem from Sioux City to the mouth to protect cities and industrial and agricultural areas against floods in the regions where reservoir control is not practicable.

It has been estimated that in the period from 1890 to 1942 a billion and a quarter acre-feet of water was the potential inflow into a comprehensive system of multiple-purpose reservoirs in the upper Missouri

Basin—an average of more than 23,000,000 acre-feet a year.

The broad program outlined in Colonel Pick's report proposes approximately 73,000,000 acre-feet of storage in the major reservoirs in the basin. This storage is well apportioned among the essential items of flood control, reclamation, navigation, and power.

This system will hold and conserve for beneficial use the excess waters from snow and ice run-off in the upper regions, the cause of the early spring floods. It will impound and control the excess waters from the later spring rainfall in the tributary basins of the lower valley which in this and in other years caused many millions of dollars of damage. In other words the proposed program will remove once and for all the fear of floods that for many years has been a handicap, in fact a definite deterrent to the industrial, civic, and agricultural development of the Missouri Valley.

Irrigation has its important role in this program. A very vital role. The plan for each multiple-purpose project will be worked out in close collaboration with the water-using agencies concerned. As it is entirely feasible to provide water in these reservoirs for irrigation the amount of land that may be irrigated by this storage can be definitely determined by the Bureau of Reclamation and put to most advantageous use. Ample food is an essence of peace as well as a mighty weapon of war.

The power potentialities of this great river will likewise be determined in collaboration with the Federal Power Commission. The plan as contained in Colonel Pick's report is, frankly, a framework, the details of which must be filled in by the coordinated efforts of all Federal, State, and local agencies concerned with the use of the water resources of this basin. Our common objective should be, and is, gain to mankind over the entire valley.

While the preparation of this plan was completed in the short space of 3 months—from May 13, 1943, when the Committee on Flood Control of the House of Representatives requested the Corps of Engineers to review previous reports on the Missouri River—this report represents the sum total of engineering study and experience of many years. The accumulated data of previous thorough surveys were immediately available for correlation and evaluation by Colonel Pick when he set out to prepare his report and to develop a comprehensive framework for the Missouri.

As I have said, the over-all development of the water resources of the Missouri Valley is of immediate and particular interest to me personally, not only because of my assignment to that territory, but also because of my belief in the coordinated, intelligent, and cooperative effort of all interested agencies. I also believe that this is an outstanding illustration of the fact that America's greatest peacetime opportunities lie not with the past but in the future. There are still frontiers in this great country of ours. All they need is the practical and courageous approach that will assure the better use of our agricultural lands, the better utilization of our water resources, and the best coordinated efforts of those agencies—Engineers, Reclamation, Agriculture, Power, and others, State and local—which are expert in their respective fields of progressive development.

Here we meet to discuss the good works of peace for the benefit of man in the midst of a war—an interruption caused by three venomous vandals bent on wartime works for the detriment and enslavement of man. Attention to the defeat of one of the two remaining vandals has, at the last minute, even deprived us of the fellowship and counsel of the Chief of Engineers. But he will be back. And soon, too, I am sure.

From the beginning we have been fighting a coalition war against the Axis. With 10 years of direct preparation and a seemingly perfect coordination finely timed to the stab-in-the-back of France by Mussolini, and Tojo's thrust at Pearl Harbor, the Axis was positive that it would overrun the smaller nations and defeat in detail Britain, Russia, China, and the United States.

For the first time in history it looked as if success would attend these despicable ambitions, and that world-shaking conquests would ensue.

China, isolated, unequipped, hung on only by her fingernails. Britain, saved by the R. A. F., "the mighty few," alone for 1 long year stemmed the westward Nazi tide. She now has gathered with us the strength, the training, and the equipment which have cleared Africa, now pound Hitler's roofless "fortress Europa," and push mightily against the "southern door." Russia, whom all the experts (except the Russians) agreed could not hold out, has ranged her millions in a human fortress which held—and, at the cost of carcasses and rivers of blood, now breaks the back of the Dnieper line.

Meanwhile we built and manufactured and shipped matériel to assist our three great allies in their desperate battles. Meanwhile we built the posts and airfields and facilities where we trained and from which we have sent a mighty army straight to the front lines. Millions have gone and many millions more will go, for just one purpose—victory.

Coalition, once only a loose system of communicated reports of individual and unrelated actions, has become a closely knit grand strategy for military victory. The wartime wisdom of this working coalition is now admitted by all. As we look toward the peace, what a parallel and a pattern it is for our interests at home. Think of the power for good if and when we pool our experience and form an intelligent coalition to solve our problems. Such a coalition will provide protection from floods as real and as ruthless as the Nazi armored flood. It will carve and stabilize channels for connecting the links of commerce; it will impound waters, not only to prevent destruction by inundation but to conserve them to moisten arid farmlands to grow food for us all. It will turn the wheels which generate electric power. No single item of such a program is more important than the others. They must be carefully fitted and dovetailed together for the best over-all results, just as you are doing here today with your own special problems. That is the way of a free and democratic people, the American way.

While we plan this great peacetime coalition—our major wartime combination effects the tightening of two steel nooses, squeezing the life from the necks of both the monsters of Mars, whose heads rise from Berlin and from Tokyo.

Hitler has nowhere to turn but inward. From the Gulf of Finland to the Sea of Azov, the Russian rampage hurls him savagely back toward Berlin. From England, in an arc across Italy and around to Iraq and Iran, the planes and ships and tanks and guns of Britain and the United States pound closer and closer. This ring of steel and fire draws tighter day by day.

Likewise, Tojo finds himself within a clockwise circular vise—a steel-toothed vise featuring the teeth of Buckner, Nimitz, MacArthur, Mountbatten, and Chiang Kai-shek.

But this is only the cementing of the coalition—the beginning—the assurance of the end to come. There is only one possible, one thinkable, conclusion in this struggle for a free world—the complete defeat of our enemies. But, though the outcome is certain, the road to victory may yet be long, as it is sure to be hard. Wars are not cheaply won against such wily and ruthless foes. Ahead lie blood and sacrifice, toil and sweat—yes, and permanent scars for all of us who wage this right-

eous fight. Yet we cannot falter at the cost, nor shirk whatever price we are called upon to pay. We must not relent or relax until the inevitable moment of final victory.

We have come a long way. We have far to go. Napoleon, by no means an ideal human being, still knew the business of war as few others have ever known it. He voiced the idea that must prevail here at this stage of our efforts when he said, "If it comes to battle, let there be victory, come what may; he who thinks of anything but this single aim is lost."

There is, however, a stronger answer to our meeting here today. It is good to plan here now. If victory fails, nothing matters anyhow. But when our certain victory comes, without farseeing, practical plans for peace, it becomes just an empty armistice.

Remember what Lincoln said when he was criticized for continuing the building of the Capitol during the War Between the States. He replied in effect that when the people saw that work continued, they would know that the Union would survive.

In the midst of our titanic struggle, we take comfort in the realization that "this too will pass away." At the end of the war, humanity once again will stand at the crossroads of history. War has hastened the change which always comes—but slowly—even in calmer times. If we are to be ready for the post-war world, we must cultivate a new concept of space, a new understanding of world conditions, a new faith in the ability of men of all races, of all faiths and creeds, of all economic conditions, to work together for peace as we are fighting together for victory. Our enemies, by the brutal force of arms, set out to impose their so-called "new order." We know that there will be a new order, but not one tailored to their sadistic ends. It will be a new order of understanding among men.

If human beings are going to live together and carry on their daily activities in the fertile valleys of our rivers and on the broad slopes and plains of our watersheds, their lives and property must be protected—protected through the conservation of their water resources—protected from destructive drought, from devastating floods, all of which discourage permanent homes, vital transportation facilities, and flourishing industries.

When the first pioneer cleared a few acres and planted his seed, he did not have a chemical analysis of the soil nor any guarantee that there would be adequate rainfall and sunshine to produce a crop. There was no Department of Agriculture to advise him nor any adequate agency to assist him if his crop failed. In the face of these and other unknown elements, the pioneer farmer forged ahead. Land that was worth only a string of beads to the Indian became valuable to the white man.

What then—if the pioneer had no theory of economics to justify his labor, no precedents to guarantee the value of the land, and about a 50-50 chance of surviving—what then spurred him on? Obviously it was faith in a divine Providence, courage, a goodly share of common sense, and a will to succeed.

With such stuff, America was carved from wilderness, plain and mountain. Man proved himself fit to survive. The post-war period will present a similar challenge. This great area needs the type of pioneering that characterized the eighteenth and nineteenth centuries. Mathematical equations and theoretical economics may not call for certain developments any more than theory justified the pioneer's risk of life. But the story of American history is ample justification. The American people will provide the pioneer spirit, if the Government will provide reasonable protection from devastating floods—reasonable programs to develop and conserve our water resources. The American people have decided that this is a proper

function of the Federal Government, and the Congress has enacted their decision into law.

Therefore let the layman, the engineer, and the Congress remember, when faced with the allegation that the present value of lands is less than the cost of a proposed improvement, that large buildings are worth more than the ground rights—that Manhattan Island was once valued at only \$24—and, above all, that the pioneer ventured and gained without the safeguards which we enjoy today.

To be specific about the points which I have covered—the comprehensive framework now proposed for the Missouri River Basin or any other major basin is not the final plan for ultimate development. There is not one single man among us, I am sure, who can foresee today the full needs of the next 50 years. Therefore, we cannot and should not attempt to establish now the full pattern of that future. What I think you want, and what I know I want, today, is action! That action is the adoption of a broad plan with every feature considered from a basin-wide standpoint—a definite plan for a practical beginning of constructive work—a flexible plan for the inspiring hopes of the future. The ideal kind of planning that I am talking about, gentlemen, is the Constitution of the United States.

In the long run, it is far more costly to do nothing than it is to do something. Two thousand years ago, this lesson was taught by the story of the slave who hid his master's talent in the ground—he feared that he might lose it. Not only did the slave lose his money, but he was cast into outer darkness. The talent of the God-given resources of this western country must be developed. Let us plan intelligently, constructively, practically, and courageously to bring forth the latent possibilities that are here. Let us work together—unselfishly and with vision—to put these plans into effect—to add to our national strength and welfare, for the greater good of us all.

PRODUCTION OF LIQUID FUEL FROM COAL

The Senate resumed consideration of the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

Mr. DAVIS obtained the floor.

Mr. MILLIKIN. Mr. President, will the Senator yield to me?

Mr. DAVIS. I yield.

Mr. MILLIKIN. I wish to submit two amendments to the bill. Before doing so, I desire to say that I am trustee of some oil-shale lands in Colorado and have a beneficial interest in the trusts. Those trusts might be hurt or helped indirectly by the enactment of the proposed legislation.

My State is enormously interested in both coal and shale, and therefore I believe I should intervene to the extent that I am intervening, and feel also that I should make the statement I have just made. I am sure that the purpose of the bill comprehends oil shale just as it comprehends coal. I think that has been developed fully in the debate here, but perhaps through an inadvertent oversight the words "oil shale" do not appear in the bill at all, and so, to make it absolutely clear, I send to the desk two brief amendments which will accomplish that purpose, and I hope the distinguished senior Senator from Wyoming [Mr. O'MAHONEY] will find the amendments acceptable.

One amendment is to the text of the bill, and the other is an amendment to the title.

The PRESIDING OFFICER. The amendments will be stated.

The CHIEF CLERK. On page 1, line 7, of the original print, after the word "coal", it is proposed to insert the words "oil shale."

Mr. O'MAHONEY. Mr. President, that amendment is quite acceptable.

The PRESIDING OFFICER. Without objection, the amendment is agreed to.

The Chair will state that after final action on the bill has been taken the amendment of the title will be in order.

Mr. O'MAHONEY. Will the Senator from Pennsylvania yield?

Mr. DAVIS. I yield.

Mr. O'MAHONEY. Last Friday night, when the Senate adjourned, the senior Senator from Connecticut [Mr. MALONEY] made inquiry of me with respect to the meaning of the provisions of section 2, which provides that sections 321 and 322 of the Act of June 30, 1932, as amended, shall not apply to any leases under this act, with respect to exemption from section 3679 of the Revised Statutes. At that time I told him that this language was incorporated in the bill from the text of the Helium Act, and that the exemptions were not at all necessary to the effectiveness of the proposed law.

Today the junior Senator from Connecticut [Mr. DANAHER] referred to the same section, and seemed to interpret it as meaning that there was a hidden purpose, contrary to the announced purpose of the Committee on Public Lands and Surveys, to permit the Department of the Interior in some way or other to operate with a hand much freer than should be the case.

The Committee on Public Lands and Surveys has insisted over and over again that the purpose of the proposed legislation is not at all to interfere with private enterprise. I believe that the interpretation which was placed upon the language by the junior Senator from Connecticut is not altogether justified by the language itself; because the second provision reads:

And such leases may be made for a term of not to exceed 5 years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

I interpret that to be an exemption only from the provisions with respect to the length of the leases. However, in order that there may be no doubt whatsoever that the purpose of the proponents of the bill is to enable the Interior Department to conduct the operations without invading the field of private enterprise, I intend to move—and I state this after having consulted with the members of the committee—that, in the second print of the bill, on page 3, lines 14 to 18, inclusive, be stricken, so that there shall be no exemption from any of the provisions of law; and that on page 1, in line 5, after the word "authorized", there be inserted the words "for not more than 5 years", so that it will not clear that, when passed, the bill will have the effect of granting this authorization for not more than 5 years, so that Congress may at any time within that

period or after that period reexamine the matter.

The PRESIDING OFFICER. The amendments will be stated, for the information of the Senate.

The CHIEF CLERK. On page 1, line 5, after the word "authorized", it is proposed to insert "for not more than 5 years."

The amendment was agreed to.

The CHIEF CLERK. On page 3, of the original print, as amended, it is proposed to strike out lines 10 to 14.

The amendment was agreed to.

Mr. DAVIS. Mr. President, the proposal to authorize the Federal Government to construct and operate demonstration-sized plants for the production of synthetic liquid fuels from coal and other materials should be approved by the Congress as quickly as possible so that this all-important research will not lag. I look upon this measure as being essential to the future of this Nation if it is to maintain its place as a world leader. Passage of the bill simply will mean this: If this work is successful, our Nation will be assured of ample supplies of synthetic petroleum products for hundreds of years, regardless of what happens to our limited reserves of natural petroleum. The bill is in every sense a national defense measure.

The bill assures continuation of our "gasoline age," and it will permit us to progress steadily in aviation. It also points the way to new industries which may provide employment for many thousands of men. It will erase the situation I most fear—that some day our United States may be required to depend on other countries for its petroleum.

In part I represent the people of the great State of Pennsylvania, a State noted for its valuable oil and coal. Our Pennsylvania petroleum is a "must" among aviation lubricants and for servicing other equipment requiring the best quality of oil. Our anthracite is the ideal household and industrial solid fuel. In this war many millions of tons of our bituminous coal have gone into blast furnaces, in the form of coke, and much of it is being funneled into dozens of channels to keep the railroads going and to keep the wheels of industry turning at a faster pace. It made the city of Pittsburgh, with its great steel mills and other heavy industries. Yes, my State owes its prominence to its coal and oil and the will of its people to produce those fuels in abundance for the well-being of the entire United States.

Pennsylvania was the first State to have a commercial oil well. Almost a century ago, near Titusville, Edward L. Drake sank a well 69½ feet into the earth and found oil. At first, development of our oil fields was slow because of the relatively small demand for petroleum. But all of us can remember the time—it was only a few years ago—when the hysterical cry of "Oil! Oil! Oil!" was heard. Derricks dotted farms, parks, and schoolyards. Oil poured forth in seemingly unending streams. Those were lush days when millionaires were made overnight, when oil was wasted because we had so much of it.

Today in Pennsylvania, Illinois, California, Texas, Oklahoma, and other States many abandoned derricks stand out against the skyline—silent markers of graves, the graves of abandoned, exhausted oil wells.

In 1759, a hundred years before the Nation's first commercial oil well came into production in Pennsylvania, the mining of bituminous coal began in the western part of my State. I think the first mining of bituminous coal was near Hancock, Md. Today, nearly 200 years later, there are abandoned mine workings in Pennsylvania, but they are not headstones—they are milestones of progress. Pennsylvania today has untold millions of tons of bituminous coal underground, far more coal than has been mined in the past. In the United States we have more than 3,000,000,000 tons of coal in reserve, enough coal to furnish sufficient oil products to supply our needs, at the present rate of consumption, for thousands of years.

And what of our reserves of natural petroleum? At the rate at which we are using oil, our known reserves are sufficient to last us about 15 years. However, this 15-year supply would have to be spread over a period of about 50 years, since production from wells decreases rather gradually as the crude is withdrawn.

This is why I urgently recommend immediate intensive research in the production of synthetic liquid fuels in the United States. Some day we must turn to coal, lignite, oil shales, and other raw materials for our oil. When that time comes we must be prepared to make the change-over quickly and efficiently; not in a helter-skelter fashion, but in an orderly and planned manner.

The measure now before us is an insurance policy. We did not have such an insurance policy regarding synthetic rubber, and we have paid and will continue to pay a high price for that lesson. We could use synthetic liquid fuels in the United States today, but we can get along without them. Some day we will not be able to say that.

Yes; thanks to American industry, we have averted a panic in synthetic rubber. But the conversion to synthetic liquid fuels cannot be handled as rapidly as that. The problem, economically and technically, is far more complex than that of synthetic rubber. We know that we can produce synthetic liquid fuels in the United States from American products. But we do not have the know-how for doing it on a commercial scale. An American method for American needs and American resources still is lacking. Great Britain's methods for liquefying coal would not give us the necessary know-how; neither would Germany's—even if we had her blueprints and operating methods. Great Britain today produces enough synthetic aviation gasoline to send 200 or 300 bombers over Germany every night, but she started large-scale studies of coal hydrogenation many years ago. Germany today produces large quantities of synthetic gasoline from coal, but Germany worked on one coal-liquefaction process from 1913 to 1926—13 years—before reaching

commercial-scale production. Both England's and Germany's synthetic fuel industries operate on a subsidy basis. Research on a large scale is the answer.

What have we been doing in the field of synthetic fuel research in the United States these many years? We have gone ahead, slowly but surely. I credit the Bureau of Mines for keeping this field of research alive in the United States.

With no fanfare, and with limited financial assistance, the Bureau has studied the liquefaction of American coals in its laboratories at Pittsburgh, Pa., since 1935. There a small staff of chemists, engineers, and physicists put together a laboratory-size pilot plant. I have seen that equipment, and it is amazingly small. Yet, with that improvised plant the Bureau has made great scientific strides. It needed new-type equipment, so it built it from odds and ends. From year to year the Bureau did not know whether enough funds would be provided to keep the project going or whether it would have to call a halt on its work. This was in the pre-war days, when service stations competed vigorously for trade and no one thought of the rationing of fuel oil or gasoline.

Yet, the Bureau kept its studies going and kept its research staff intact. Today the Bureau can report that it has tested 14 American coals and lignites in that plant, and all produced good gasoline, fuel oil, lubricants, and similar petroleum products.

One American coal produced as much as 136 gallons of gasoline per ton; another, 134 gallons. The well-known Pittsburgh bed of my State turned out 130 gallons per ton of coal. Further research can improve the yield.

The laboratory plant of the Bureau at Pittsburgh is complicated. It requires experts to operate it—to turn the right knobs at the proper time, and to make spare parts so that it can produce the mere trickle of gasoline it is capable of producing, since the equipment is able to handle only 100 pounds of coal every 24 hours.

I should mention, also, the Bureau's experiments in the production of petroleum products from oil shale. As I recall, the Bureau's work in that field of research began about 1925, but was brought to an abrupt close in 1929 because of lack of funds. In that short time, however, the Bureau ran about 6,000 tons of domestic oil shale through a retort near Rulison, in Colorado, and produced about 3,600 barrels of oil. According to Secretary of the Interior Ickes, we have enough oil shale in the United States to produce some 92,000,000,000 barrels of oil—about a 65-year supply. Yet, as in the case of coal liquefaction, we have no workable, commercial-scale process for utilizing that oil shale. Again, the Bureau of Mines has not been given a chance to carry on its investigative work on a scale which would provide all the answers preliminary to commercial utilization.

Senators, by the time this war is over we may not have a 15-year supply of natural petroleum. We may by new discoveries have a 30-year supply. On

the other hand, we may not even have a 10-year supply. I would be the last one to predict when this war will end, because I believe firmly that nothing is as dangerous as over-optimism.

During the recent recess the subcommittee of the Senate Committee on Public Lands and Surveys, of which the Senator from Wyoming [Mr. O'MAHONEY] is chairman, held a series of hearings of Senate bill 1243. I was glad to have the opportunity afforded me by the distinguished senior Senator from Wyoming to participate in the hearings which were held in Pittsburgh. At the first hearing in Washington, D. C., there appeared Brig. Gen. W. E. R. Covell, of the Fuel and Lubricants Division, Quartermaster General's Office, United States Army.

I quote General Covell's short, but extremely significant testimony:

While at the present time there is no indicated shortage of liquid fuels for military and essential civilian uses, the supply of crude oil in the continental United States is diminishing; therefore, it is deemed advisable to explore the possibilities of producing synthetic liquid fuels, and to familiarize industry with the operation of such plants so that they may be used in the event of shortage of petroleum supplies.

In modern warfare as we know it today, liquid fuels are absolutely essential. Over half—in north Africa, 65 percent—of the tonnage of all supplies for our Army overseas is petroleum products.

From the viewpoint of over-all strategic considerations, any successful developments along the lines indicated will provide a factor of safety against any unforeseen turn of events in this war and might be absolutely essential in the event we are unfortunate enough to be engaged in another world war in the future.

Senators, I agree wholeheartedly with this authoritative statement. It is our duty, the duty of our Government, to pave the way for large-scale production of synthetic liquid fuels from coal and other materials "so that they may be used in the event of a shortage of petroleum supplies," as stated by General Covell.

Our Government is best equipped to continue this vital research, provide the "know how" for industry, and erase forever the growing fear that some day in the not-too-distant future we may become a weakling, a stagnated civilization depending on foreign sources for our lifeblood—liquid fuels. It is our solemn duty to banish forever any indecision involving our future as the leader of democracy.

The bill should be passed, and should be implemented as soon as possible with appropriations so that the work may be advanced without delay.

The PRESIDING OFFICER. The bill is before the Senate and open to further amendment.

Mr. REVERCOMB. Mr. President, I offer the following amendment: On page 3, line 3 of the copy of the bill which is on our desks, after the word "property" I propose that the following language be added:

Provided, however, That the maximum quantity of land, or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on the experiments for the purposes herein provided.

Mr. O'MAHONEY. Mr. President, will the Senator yield?

Mr. REVERCOMB. I yield.

Mr. O'MAHONEY. The Senator from West Virginia has spoken to me about the amendment he has just offered. I have no objection to it. I feel that the purpose of the measure in its authorization to the Secretary of the Interior to acquire land is merely to enable him to secure such land as may be necessary for experimental purposes. I think the Senator has stated the purpose as the committee understood it, and I am glad to accept the amendment.

Mr. REVERCOMB. I thank the Senator from Wyoming.

The PRESIDING OFFICER. The clerk will state the amendment offered by the Senator from West Virginia for the information of the Senate.

The CHIEF CLERK. On page 3, line 3, after the word "property", it is proposed to insert:

Provided, however, That the maximum quantity of land, or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on the experiments for the purposes herein provided.

The PRESIDING OFFICER. The question is on agreeing to the amendment proposed by the Senator from West Virginia.

The amendment was agreed to.

The PRESIDING OFFICER. The bill is before the Senate, and is open to further amendment. If there be no further amendment to be offered, the question is on the engrossment and the third reading of the bill.

The bill (S. 1243) was ordered to be engrossed for a third reading, read the third time, and passed.

The title was amended so as to read:

A bill authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

Mr. O'MAHONEY. Mr. President, inasmuch as many amendments have been made to the bill, I ask unanimous consent to have the full text of the bill as passed printed in full in the RECORD.

The PRESIDING OFFICER. Without objection, it is so ordered.

The bill (S. 1243), as passed, is as follows:

Be it enacted, etc., That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than 5 years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. There is hereby authorized to be appropriated not to exceed \$30,000,000 for the purposes of this act. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total na-

tional commercial sale and distribution of petroleum and petroleum products.

SEC. 2. In order to carry out the purpose of this act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work and with pilot plants and semiworks plants make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, or donation, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: *Provided, however,* That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this act.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this act. No patent or patent rights acquired by the Secretary of the Interior under this act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process to which such patent or patent rights relate, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

SEC. 4. All moneys received under this act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the 1st day of January of each year a report of all operations under this act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this act. The authority and duties of the Secretary of the Interior under this act shall be exercised through the Bureau of Mines of the Department of the Interior.

Mr. O'MAHONEY. Mr. President, I was about to read a letter addressed to the chairman of the Committee on Public Lands and Surveys [Mr. Hatch], from the First Assistant Secretary of the In-

terior, Michael W. Straus, transmitting a letter from the Director of the Bureau of the Budget with respect to Senate bill 1243. I also have before me a letter, relative to the bill, from R. R. Sayers, Director of the Bureau of Mines. I ask unanimous consent that the letters be printed in the RECORD at this point.

There being no objection, the letters were ordered to be printed in the RECORD, as follows:

UNITED STATES
DEPARTMENT OF THE INTERIOR,
Washington, November 8, 1943.

Hon. CARL A. HATCH,
Chairman, Committee on Public Lands
and Surveys, United States Senate.

MY DEAR SENATOR HATCH: In response to a request for immediate notification of any report by the Bureau of the Budget as to whether S. 1243 is within the President's program, I attach herewith a letter received today on that subject from the Director of the Budget. You will note that the Director concludes "that there would be no objection to the enactment of legislation authorizing this undertaking as a post-war project" and precedes this conclusion with the statement that "the construction of these plants during the present war should not be considered in accord with the program of the President."

S. 1243, as you recall, stipulates no time schedule in relationship with the war. The testimony of the Department, industry, and other officials was to the effect that any interference with the President's war program would be avoided, following passage of this authorization bill, by submission of priority requirements on material to the War Production Board, labor requirements to the War Manpower Commission, financial items to the Bureau of the Budget, and any other items to appropriate Federal agencies. This procedure would insure compliance with the changing requirements of the war program. Therefore, the concept of the Department, and the bill as written, would seem to be in accord with the stipulation of the Bureau of the Budget. The Department could not feel free to proceed with the essential preliminary work prerequisite to this large undertaking, unless definitive Senate action is taken on S. 1243.

Sincerely yours,
MICHAEL W. STRAUS,
First Assistant Secretary.

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D. C., November 8, 1943.

The honorable the SECRETARY OF THE INTERIOR,
My DEAR MR. SECRETARY: Reference is made to prior correspondence concerning proposed legislation to authorize the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war and conserve and increase the oil resources of the Nation.

Your letter of October 25, 1943, indicates that you would contemplate the construction, under this legislation, of three plants, with a total investment cost of \$50,000,000, and with annual operating costs of \$7,810,000. In this connection it is to be noted that the House bill, as reported to the House, fixes a total appropriation authorization of \$30,000,000.

Expert testimony before the subcommittee of the Committee on Public Lands and Surveys of the Senate indicated the contemplated program could not be looked upon as an important aid to the prosecution of the present war, or even to meeting the immediate post-war petroleum requirements. Moreover, the present construction of these plants would make considerable demand upon our supply of manpower and critical materials.

In view of these considerations you are advised that legislation contemplating the construction of these plants during the present war should not be considered in accord with the program of the President, but that there would be no objection to the enactment of legislation authorizing this undertaking as a post-war project.

Very truly yours,
HAROLD D. SMITH,
Director.

UNITED STATES DEPARTMENT OF THE INTERIOR,
BUREAU OF MINES,
Washington, D. C., November 2, 1943.
Hon. JOSEPH C. O'MAHONEY,
United States Senate.

MY DEAR SENATOR O'MAHONEY: This is in response to your telephone request regarding the plans of the Bureau of Mines with respect to carrying out the purposes of bill S. 1243 authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances.

The first step in this program is the requesting of appropriations for the fiscal year ending June 30, 1945, in accordance with section 2 (a) of the bill for conducting the laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation for these plants.

This work will be started as soon as the appropriation is available. A survey of the situation with respect to availability of men and materials indicates that this part of the project will not be impossible to carry out because of lack of materials or men if reasonable priorities in keeping with war needs are granted.

The Bureau of Mines program will include (a) the Bergius process for the direct hydrogenation and liquefaction of coal; (b) the Fischer-Tropsch process for the production of synthetic liquid fuels from coal or lignite; (c) the low-temperature carbonization of coal in conjunction with either process (a) or (b); and (d) the distillation of oil shale.

In order to take advantage of the best available advice in carrying out the objectives of S. 1243, it is planned to appoint an advisory technical committee composed of recognized authorities in this field of research and development. These appointees will be selected from the interested industries and from research organizations working in related fields. The Bureau has found such advisory committees helpful in planning new projects, and in the present instance the Bureau would give careful consideration to the advice of this committee in deciding on the nature, capacity, and location of the demonstration plants and in the planning and conducting of the research and development work necessary to determine the best demonstration plant designs and conditions of operation. It will be necessary to assemble considerable data and carry out some of the work covered by section 2 (a) of the bill before decisions on location of demonstration plants can be made.

Sincerely yours,
R. R. SAYERS,
Director.

THE CALENDAR

Mr. BARKLEY. Mr. President, it is my desire to have a call of the calendar beginning at the point where we left off at the last call.

It is also my purpose later to move that the Senate adjourn until Friday. Thursday is Armistice Day, and many Senators will be absent. On Friday it is intended to take up the Bankhead newspaper advertisement bill.

I ask unanimous consent that the Senate now proceed to the consideration of bills on the calendar to which there is no objection, beginning with Calendar No. 486.

The PRESIDING OFFICER (Mr. CLARK of Missouri in the chair). Is there objection? The Chair hears none, and the clerk will proceed to state the measures on the calendar, beginning with Calendar No. 486.

MORRIS LEFF

The bill (H. R. 244) for the relief of Morris Leff, was considered, ordered to a third reading, read the third time, and passed.

FARRELL-ARGAST ELECTRIC CO.

The bill (H. R. 560) for the relief of the Farrell-Argast Electric Co. was considered, ordered to a third reading, read the third time, and passed.

MITTIE PEARL NANNY

The Senate proceeded to consider the bill (H. R. 937) for the relief of Mittie Pearl Nanny, which had been reported from the Committee on Claims with an amendment on page 1, line 5, after the word "to", to strike out "Mittie Pearl Nanny" and insert "the estate of Luther Clyde Nanny."

The amendment was agreed to.

The amendment was ordered to be engrossed, and the bill to be read a third time.

The bill was read the third time and passed.

The title was amended so as to read: "An act for the relief of the estate of Luther Clyde Nanny."

ESTATE OF HYMAN WIENER

The bill (H. R. 1049) for the relief of the estate of Hyman Wiener was considered, ordered to a third reading, read the third time, and passed.

HELEN ENGELL THOMPSON

The bill (H. R. 1666) for the relief of Helen Engell Thompson was considered, ordered to a third reading, read the third time, and passed.

LILLIAN C. FERREIRA

The bill (H. R. 1435) for the relief of Lillian C. Ferreira was considered, ordered to a third reading, read the third time, and passed.

INA MAE SHIPMAN

The bill (H. R. 1769) for the relief of Mrs. Ina Mae Shipman was considered, ordered to a third reading, read the third time, and passed.

EDWARD A. SILVIA

The bill (H. R. 1918) for the relief of Edward A. Silvia was considered, ordered to a third reading, read the third time, and passed.

NELLIE STARR McCORKLE

The bill (H. R. 2675) providing for payment to Nellie Starr McCorkle of accumulated leave accrued and payable to her deceased husband, Capt. John Ray McCorkle, under the act of August 1, 1941 (ch. 348, 55 Stat. 616; 5 U. S. C., sec. 61a), was considered, ordered to a third reading, read the third time, and passed.

HAROLD E. DALTON

The bill (H. R. 1887) for the relief of Harold E. Dalton was considered, ordered to a third reading, read the third time, and passed.

MARCUS O. AND FAYE D. ROWLAND, PARENTS OF GEORGE L. ROWLAND, DECEASED

The bill (H. R. 1920) for the relief of Marcus O. and Faye D. Rowland, the parents of George L. Rowland, deceased, was considered, ordered to a third reading, read the third time, and passed.

SIGURD J. E. WALLSTEDT

The bill (H. R. 400) for the relief of Sigurd J. E. Wallstedt was considered, ordered to a third reading, read the third time, and passed.

SETTLEMENT OF CERTAIN CLAIMS OF NAVAL PERSONNEL

The bill (H. R. 273) to authorize settlement of individual claims of naval personnel for damage to private property shipped from Pearl Harbor, Hawaii, to San Francisco, Calif., was considered, ordered to a third reading, read the third time, and passed.

JOHN E. HAAS

The bill (H. R. 2182) for the relief of John E. Haas was considered, ordered to a third reading, read the third time, and passed.

RICHARD P. BEALE AND EVA M. BEALE

The bill (H. R. 247) for the relief of Richard P. Beale and Eva M. Beale was considered, ordered to a third reading, read the third time, and passed.

The title was amended so as to read: "An act for the relief of the estate of Richard Dodge Beale, deceased."

MARGUERITE R. McELROY

The Senate proceeded to consider the bill (H. R. 2190) for the relief of Marguerite R. McElroy, which had been reported from the Committee on Claims with an amendment, on page 1, line 6, after the words "sum of", to strike out "\$150", and insert "\$98.75."

The amendment was agreed to.

The amendment was ordered to be engrossed, and the bill to be read a third time.

The bill was read the third time and passed.

NEOLA CECILE TUCKER

The Senate proceeded to consider the bill (S. 921) for the relief of Mrs. Neola Cecile Tucker, which had been reported from the Committee on Claims with an amendment, on page 1, line 5, after the words "sum of", to strike out "\$10,000" and insert "\$5,000", so as to make the bill read:

Be it enacted, etc., That the Secretary of the Treasury be, and he is hereby, authorized and directed to pay, out of any money in the Treasury not otherwise appropriated, the sum of \$5,000 to Mrs. Neola Cecile Tucker, of Houma, La., in full settlement of all claims against the United States for the death of her husband, Dr. William Lee Tucker, a first lieutenant in the Medical Corps of the Army, who was killed by a train at De Quincy, La., while under Army escort to a psychiatric hospital: *Provided*, That no part of the amount appropriated in this act in excess of 10 per-

cent thereof shall be paid or delivered to or received by any agent or attorney on account of services rendered in connection with this claim, and the same shall be unlawful, any contract to the contrary notwithstanding. Any person violating the provisions of this act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not exceeding \$1,000.

The amendment was agreed to.

The bill was ordered to be engrossed for a third reading, read the third time, and passed.

ALICE STAMPS AND HENRIETTA E. STAMPS

The bill (H. R. 2824) for the relief of Alice Stamps and Henrietta E. Stamps, was considered, ordered to a third reading, read the third time, and passed.

FRED A. FLANDERS

The bill (H. R. 1144) for the relief of Fred A. Flanders was considered, ordered to a third reading, read the third time, and passed.

M. C. ROBERTS

The bill (H. R. 2600) for the relief of M. C. Roberts was considered, ordered to a third reading, read the third time, and passed.

ALBERT FERGUSON AND OZELLE FERGUSON

The Senate proceeded to consider the bill (H. R. 1973) for the relief of Albert Ferguson and Ozelle Ferguson, which had been reported from the Committee on Claims with an amendment, on page 1, line 6, after the words "sum of", to strike out "\$2,500", and insert "\$3,500."

The amendment was agreed to.

The amendment was ordered to be engrossed, and the bill to be read a third time.

The bill was read the third time and passed.

WILLIAM CARROLL KNOX

The Senate proceeded to consider the bill (S. 1290) for the relief of William Carroll Knox, which had been reported from the Committee on Claims with an amendment, on page 1, line 6, after the words "sum of", to strike out "\$188.20", and insert "\$186.65", so as to make the bill read:

Be it enacted, etc., That the Secretary of the Treasury is authorized and directed to pay, out of any money in the Treasury not otherwise appropriated, to William Carroll Knox, of Winchester, Tenn., the sum of \$186.65, in full satisfaction of his claim against the United States for compensation for services rendered as United States commissioner at Winchester, Tenn., for the period from October 22, to November 23, 1942, inclusive, such claim having been disallowed by reason of the fact that his term of office as such commissioner expired prior to the time such services were rendered: *Provided*, That no part of the amount appropriated in this act in excess of 10 percent thereof shall be paid or delivered to or received by any agent or attorney on account of services rendered in connection with this claim, and the same shall be unlawful, any contract to the contrary notwithstanding. Any person violating the provisions of this act shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined in any sum not exceeding \$1,000.

The amendment was agreed to.

The bill was ordered to be engrossed



CONSIDERATION OF H. R. 3209

FEBRUARY 10, 1944.—Referred to the House Calendar and ordered to be printed

Mr. SABATH, from the Committee on Rules, submitted the following

REPORT

[To accompany H. Res. 434]

The Committee on Rules, having had under consideration House Resolution 434, report the same to the House with the recommendation that the resolution do pass.

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11 to be equally divided and controlled by the chairman and
12 ranking minority member of the Committee on Mines and

1 Mining, the bill shall be read for amendment under the five-
 2 minute rule. At the conclusion of the reading of the bill
 3 for amendment, the Committee shall rise and report the
 4 same to the House with such amendments as may have been
 5 adopted and the previous question shall be considered as or-
 6 dered on the bill and amendments thereto to final passage
 7 without intervening motion except one motion to recommit.

House Calendar No. 181

78TH CONGRESS
2d Session

H. RES. 434

[Report No. 1115]

RESOLUTION

Providing for the consideration of H. R. 3209,
 a bill authorizing the construction and oper-
 ation of demonstration plants to produce
 synthetic liquid fuels from coal and other
 substances, in order to aid the prosecution
 of the war, to conserve and increase the oil
 resources of the Nation, and for other pur-
 poses.

By Mr. SARATIN

FEBRUARY 10, 1944

Referred to the House Calendar and ordered to be
 printed

1 Mining, the bill shall be read for amendment under the five-
2 minute rule. At the conclusion of the reading of the bill
3 for amendment, the Committee shall rise and report the
4 same to the House with such amendments as may have been
5 adopted and the previous question shall be considered as or-
6 dered on the bill and amendments thereto to final passage

Hoch	Marcantonio	Sauthoff
Hollfield	Merritt	Sheppard
Holmes, Wash.	Michener	Sheridan
Howell	Monroney	Sikes
Izac	Morrison, N. C.	Simpson, Ill.
Jackson	Mott	Slaughter
Jarman	Mruk	Smith, Maine
Jenkins	Murdoch	Snyder
Johnson,	Murphy	Somers, N. Y.
Calvin D.	Myers	Sparkman
Johnson,	Norman	Spence
J. Leroy	O'Brien, Ill.	Stanley
Johnson,	O'Brien, Mich.	Stewart
Luther A.	O'Hara	Stockman
Johnson,	O'Neal	Sullivan
Lyndon B.	Outland	Sumners, Tex.
Judd	Pace	Tarver
Kean	Patman	Thomas, Tex.
Kefauver	Patton	Thomason
Kerr	Peterson, Fla.	Tolan
Kilburn	Peterson, Ga.	Vinson, Ga.
Kilday	Pfeifer	Voorhis, Calif.
King	Philbin	Wadsworth
Kirwan	Plumley	Ward
Klein	Priest	Wasielewski
Lane	Ramey	Weiss
Larcade	Randolph	Welch
Lea	Rankin	Wene
LeCompte	Reece, Tenn.	White
Lemke	Reed, Ill.	Whittington
Lesinski	Richards	Willey
Luce	Robertson	Winstead
McCormack	Robinson, Utah	Wolverton, N. J.
McMurray	Rockwell	Woodrum, Va.
Madden	Rogers, Mass.	Worley
Maloney	Rowan	Wright
Manasco	Sabath	Zimmerman
Mansfield,	Sadowski	
Mont.	Sasser	

NAYS—158

Abernethy	Gillette	Mills
Andersen,	Gillie	Murray, Tenn.
H. Carl	Goodwin	Murray, Wis.
Andresen,	Gossett	Norrell
August H.	Graham	O'Brien, N. Y.
Andrews	Grant, Ind.	O'Konski
Arends	Griffiths	Phillips
Arnold	Gwynne	Pittenger
Auchincloss	Hagen	Poage
Bates, Mass.	Hall,	Poulson
Bender	Edwin Arthur	Powers
Bennett, Mich.	Hall,	Pratt,
Bennett, Mo.	Leonard W.	Joseph M.
Bishop	Hancock	Reed, N. Y.
Blackney	Harness, Ind.	Rees, Kans.
Bolton	Hays	Rivers
Boren	Hoeven	Rizley
Bradley, Mich.	Hope	Rolph
Brown, Ohio	Hull	Rowe
Brumbaugh	Jeffrey	Russell
Bryson	Jennings	Satterfield
Buffett	Jensen	Schiffler
Busbey	Johnson,	Schwabe
Butler	Anton J.	Scott
Canfield	Johnson, Ind.	Scrivner
Carlson, Kans.	Johnson, Okla.	Shafer
Carson, Ohio	Johnson, Ward	Short
Carter	Jones	Simpson, Pa.
Chapfield	Jonkman	Smith, Ohio
Clevenger	Kearney	Smith, Wis.
Compton	Keefe	Springer
Costello	Kinzer	Starnes, Ala.
Courtney	Knutson	Stearns, N. H.
Cravens	Kunkel	Stefan
Crawford	Lambertson	Stevenson
Cunningham	Lanham	Sumner, Ill.
Curtis	LeFevre	Sundstrom
Day	Lewis	Taber
Dies	Ludlow	Talbot
Disney	McConnell	Talle
Dondero	McCowan	Tibbott
Elliot	McGehee	Towe
Ellis	McGregor	Treadway
Elmer	McKenzie	Troutman
Engel, Mich.	McMillan	Vincent, Ky.
Fellows	McWilliams	Vursell
Fisher	Maas	West
Fuller	Mahon	Whelchel, Ga.
Gale	Martin, Iowa	Whitten
Gallagher	Mason	Wickersham
Gathings	Morrow	Wiglesworth
Gavin	Miller, Conn.	Wolcott
Gerlach	Miller, Mo.	Wolfenden, Pa.
Gibson	Miller, Nebr.	Woodruff, Mich.
Gilchrist	Miller, Pa.	

NOT VOTING—83

Baldwin, Md.	Celler	Domengeaux
Bell	Cole, Mo.	Douglas
Boykin	Cole, N. Y.	Drewry
Buckley	Cooley	Dworshak
Burch, Va.	Cullen	Eaton
Burdick	Curley	Elston, Ohio
Cannon, Fla.	Dawson	Fenton
Case	Dirksen	Fish

Fulmer	Keogh	Pracht,
Gamble	Kleberg	C. Frederick
Gifford	LaFollette	Price
Gorski	Landis	Rabaut
Gross	Lynch	Ramspeck
Halleck	McCord	Robson, Ky.
Hare	McLean	Rodgers, Pa.
Harris, Va.	Magnuson	Rogers, Calif.
Hartley	Mansfield, Tex.	Rohrbough
Hebert	Martin, Mass.	Scanlon
Heffernan	May	Smith, Va.
Heldinger	Monkiewicz	Smith, W. Va.
Hess	Morrison, La.	Taylor
Hobbs	Mundt	Thomas, N. J.
Hoffman	Newsome	Vorys, Ohio
Holmes, Mass.	Norton	Walter
Horan	O'Connor	Weaver
Kee	O'Leary	Welchel, Ohio
Kelley	O'Toole	Wilson
Kennedy	Ploeser	Winter

So the bill was passed.

The Clerk announced the following pairs:

On this vote:

Mr. Keogh for, with Mr. C. Frederick Pracht against.

Mr. Drewry for, with Mr. Fenton against.

Mr. Lynch for, with Mr. Hartley against.

Mr. Curley for, with Mr. Thomas of New Jersey against.

Mr. Heffernan for, with Mr. Elston of Ohio against.

Mr. Hobbs for, with Mr. Ploeser against.

Mr. Kennedy for, with Mr. Welch of Ohio against.

Mr. Buckley for, with Mr. Rodgers of Pennsylvania against.

Mr. O'Toole for, with Mr. Hess against.

Mr. Morrison of Louisiana for, with Mr. McLean against.

Mr. Celler for, with Mr. Eaton against.

Mrs. Norton for, with Mr. Gross against.

General pairs:

Mr. Rabaut with Mr. Burdick.

Mr. Domengeaux with Mr. Martin of Massachusetts.

Mr. Price with Mr. Halleck.

Mr. Magnuson with Mr. Dirksen.

Mr. O'Leary with Mr. Fish.

Mr. Kleberg with Mr. Gifford.

Mr. Fulmer with Mr. Monkiewicz.

Mr. Cullen with Mr. Robson of Kentucky.

Mr. Ramspeck with Mr. Rohrbough.

Mr. Newsome with Mr. Vorys of Ohio.

Mr. Hébert with Mr. Winter.

Mr. May with Mr. Horan.

Mr. Mansfield of Texas with Mr. Gamble.

Mr. Bell with Mr. Douglas.

Mr. Hare with Mr. Mundt.

Mr. Boykin with Mr. Taylor.

Mr. Kee with Mr. Wilson.

Mr. McCord with Mr. Case.

Mr. Smith of Virginia with Mr. LaFollette.

Mr. Weaver with Mr. Cole of Missouri.

Mr. Burch of Virginia with Mr. Landis.

Mr. Smith of West Virginia with Mr. Cole of New York.

Mr. Harris of Virginia with Mr. Dworshak.

Mr. Scanlon with Mr. Heldinger.

Mr. Baldwin of Maryland with Mr. Hoffman.

Mr. O'Connor with Mr. Holmes of Massachusetts.

The result of the vote was announced as above recorded.

A motion to reconsider was laid on the table.

The doors were opened.

Mr. PETERSON of Florida. Mr. Speaker, I ask unanimous consent to take from the Speaker's table, the bill, S. 1140, and strike out all after the enacting clause and insert in lieu thereof the provisions of the House bill just passed.

The Clerk read the title of the Senate bill.

The SPEAKER. Is there objection to the request of the gentleman from Florida [Mr. PETERSON]?

There was no objection.

The Clerk read the Senate bill, as follows:

Be it enacted etc., That there shall be in the Department of the Interior an additional Assistant Secretary of the Interior, who shall be appointed by the President, by and with the advice and consent of the Senate, and who shall perform such duties in the Department of the Interior as shall be prescribed by the Secretary, or may be required by law. The Assistant Secretaries of the Interior shall be without numerical distinction of rank and shall have salaries of \$9,000 per annum. The additional office provided for by this act shall cease to exist at the expiration of 6 months after the cessation of hostilities in the present war as determined by the President by proclamation or by the Congress by concurrent resolution.

Mr. PETERSON of Florida. Mr. Speaker, I move to strike out all after the enacting clause and insert the provisions of H. R. 2801 as amended.

The Clerk read as follows:

Mr. PETERSON of Florida moves to strike out all after the enacting clause of the Senate bill and insert the provisions of H. R. 2801 as amended.

The motion was agreed to.

The Senate bill was ordered to be read a third time, was read the third time and passed, and a motion to reconsider was laid on the table.

By unanimous consent, the proceedings by which the bill H. R. 2801 was passed, were vacated and the bill was laid on the table.

EXTENSION OF REMARKS

Mr. CANNON of Missouri. Mr. Speaker, I ask unanimous consent to extend my remarks and insert a letter from a constituent.

The SPEAKER. Is there objection?

There was no objection.

[The matter referred to will appear hereafter in the Appendix.]

JEWS IN PALESTINE

Mr. PFEIFER. Mr. Speaker, I ask unanimous consent to address the House for 1 minute and to revise and extend my remarks.

The SPEAKER. Is there objection? There was no objection.

[Mr. PFEIFER addressed the House. His remarks will appear in the Appendix of today's RECORD.]

EXTENSION OF REMARKS

Mr. BURCHILL of New York. Mr. Speaker, I ask unanimous consent that my colleague from New York [Mr. LYNCH] may extend his own remarks by inserting a small article.

The SPEAKER. Is there objection?

There was no objection.

[The matter referred to appears in the Appendix.]

CORRECTION OF THE ROLL CALL

Mrs. ROGERS of Massachusetts. Mr. Speaker, I desire to correct the roll call No. 26 on February 10. I am recorded as not voting. I was present and voted "aye." I ask unanimous consent that the RECORD and Journal be corrected accordingly.

The SPEAKER. Without objection, the RECORD and Journal will be corrected accordingly.

There was no objection.

EXTENSION OF REMARKS

Mr. WELCH. Mr. Speaker, I ask unanimous consent to revise and extend my remarks and include therein a Reuters news dispatch, dealing with international air route operation by surface shipping companies.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

Mr. JENNINGS. Mr. Speaker, I ask unanimous consent to extend my remarks and include a short address.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

Mr. TALBOT. Mr. Speaker, I ask unanimous consent to extend my remarks in the RECORD and include a magazine article prepared by my colleague the gentleman from Connecticut [Mrs. LUCE].

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

Mr. SHORT. Mr. Speaker, I ask unanimous consent to extend my remarks and insert a brief newspaper article.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

Mr. SHORT. Mr. Speaker, I also ask unanimous consent to extend my remarks and include a letter from a former Member of the House.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

Mr. GORDON. Mr. Speaker, I ask unanimous consent to extend my remarks in the RECORD and include an article based on a radio address by former Ambassador Bullitt in relation to the Polish question.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

(By unanimous consent, Mr. HAYS was granted permission to revise and extend his own remarks in the Appendix of the RECORD.)

Mr. ROWAN. Mr. Speaker, I ask unanimous consent to extend my remarks and include an editorial from the Chicago Times.

The SPEAKER. Is there objection?
There was no objection.

[The matter referred to appears in the Appendix.]

PERMISSION TO ADDRESS THE HOUSE

Mr. DICKSTEIN. Mr. Speaker, I ask unanimous consent that after any other special orders today I may address the House for 10 minutes.

The SPEAKER. Is there objection?
There was no objection.

SYNTHETIC LIQUID FUELS FROM COAL AND OTHER SUBSTANCES

Mr. SABATH. Mr. Speaker, I call up the resolution, House Resolution 434, and ask for its immediate consideration.

The Clerk read the resolution, as follows:

Resolved, That upon the adoption of this resolution it shall be in order to move that the House resolve itself into the Committee of the Whole House on the state of the Union for the consideration of the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes. That after general debate, which shall be confined to the bill and continue not to exceed 2 hours, to be equally divided and controlled by the chairman and ranking minority member of the Committee on Mines and Mining, the bill shall be read for amendment under the 5-minute rule. At the conclusion of the reading of the bill for amendment, the committee shall rise and report the same to the House with such amendments as may have been adopted and the previous question shall be considered as ordered on the bill and amendments thereto to final passage without intervening motion except one motion to recommit.

Mr. SABATH. Mr. Speaker, later on I shall yield 30 minutes to the gentleman from New York [Mr. ALLEN], minority member of the Rules Committee.

Mr. Speaker, this is again an open rule. It provides for 2 hours' general debate and then the bill will be taken up under the 5-minute rule as usual.

This is an important measure that the resolution makes in order. I understand that for 2 or 3 years a Senate committee has given a great deal of thought and consideration to this proposition. The House Committee on Mines and Mining has also made a study of the need for this legislation, and the Committee on Rules, upon being informed that that committee reported the bill unanimously, granted a rule by unanimous vote.

The bill authorizes the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical material available, to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances, with all facilities and accessories for the manufacture, processing, and testing of such fuel.

Only a few minutes ago my attention was called to an article appearing in the Washington Evening Star, showing that the Truman committee in a report stresses the need for additional fuel. That committee is fearful, and other reports indicate, that we really have only 5 or 6 years' supply of oil. I hope that report is not correct. I do feel that we have a greater supply than has been reported, because otherwise we really would be in danger.

This proposal aims to utilize the cheapest possible coal for the purpose of producing this fuel. Now, this is nothing new. In Germany, almost one-half of the fuel and gasoline has been produced in this manner.

The Department here under the direction and supervision of the Secretary of the Interior, for years has been investigating and developing this process, and I am informed they have improved materially upon the German method. If this be so, we are indeed in a splendid position, because we have enough coal to last us for a thousand years. The cheap coal that will be used for this purpose is available in nearly every section of the country. Some have chided me that there was a lot of cheap coal in Illinois, but in reply I say there is cheap coal not only in Illinois and Indiana but in almost all sections of the country. Experimentation at the small laboratory of the Bureau of Mines operating at Pittsburgh has demonstrated that the methods used in Europe could be applied to American coals and lignite, and yields have been determined for coals from 14 States and Alaska, one from Illinois showing a yield of 122 gallons of gasoline to the ton.

It is contemplated to build one, two, or three plants and make such improvements in the process as will reduce the cost. I think it is absolutely necessary that we not delay any longer the development of these plants. This is one time that I cannot be charged with delay in reporting a rule, because the Committee on Mines and Mining only reported the bill on the 10th of this month. The rule was granted a few days afterward, and here on the 15th we have the bill before us for consideration.

Mr. Speaker, I have been informed that some Members are desirous of leaving early, so I am not going to take any more of your time. I believe the bill has such merit that we will all feel it should be passed without any delay. Mr. Speaker, I reserve the balance of my time and now yield 30 minutes to the gentleman from Illinois [Mr. ALLEN]. I know he will direct attention to the recommendations that have been made by the heads of certain bureaus that made a thorough study of this subject and also to the hearings that were held on this important measure.

Mr. Speaker, before I conclude I ask unanimous consent to revise and extend my own remarks, the remarks I made earlier in the day and the remarks I am just concluding.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

Mr. ALLEN of Illinois. Mr. Speaker, the chairman of the committee has so splendidly outlined the points of this resolution that I will take no more time on this side than to say there is no objection to the rule. The only thing is that some Members on the minority side feel that private industry should undertake most of these experiments in regard to oil.

Mr. Speaker, I yield back the balance of my time to the chairman of the committee.

Mr. SABATH. Mr. Speaker, in view of what I said that many Members desire to leave early I move the previous question on the resolution.

The previous question was ordered.
The resolution was agreed to.

Mr. PETERSON of Florida. Mr. Speaker, I move that the House resolve itself into the Committee of the Whole House on the state of the Union for the consideration of the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

The motion was agreed to.

Accordingly the House resolved itself into the Committee of the Whole House on the state of the Union for the consideration of the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, with Mr. DELANEY in the chair.

The Clerk read the title of the bill.

By unanimous consent, the first reading of the bill was dispensed with.

The CHAIRMAN. Under the rule, the gentleman from Florida [Mr. PETERSON] is recognized for 1 hour and the gentleman from Michigan [Mr. BRADLEY] is recognized for 1 hour.

Mr. PETERSON of Florida. Mr. Chairman, I yield myself such time as I may use.

The CHAIRMAN. The gentleman from Florida is recognized.

Mr. PETERSON of Florida. Mr. Chairman, this is a very far-sighted measure. The Committee on Mines and Mining gave very thorough study to the subject and this bill under the very splendid leadership of the chairman of the subcommittee the gentleman from West Virginia [Mr. RANDOLPH]. They conducted extensive hearings of their own and also in conjunction with the Senate committee. The dates and facts of the hearings will be developed by the gentleman from West Virginia. The hearings show that the committee gave long and continued study to the subject and has presented a very far-sighted solution of a problem we should meet now, must meet in the immediate future, and which we should have met, if I may speak as an observer, long ago, for I believe that had we taken this step some years ago we would not have been caught short as we were at the beginning of the war.

As I say, this study was conducted by a subcommittee under the able chairmanship of the distinguished gentleman from West Virginia [Mr. RANDOLPH], and then acted upon by the full Committee on Mines and Mining.

Mr. DONDERO. Mr. Chairman, will the gentleman yield for a question?

Mr. PETERSON of Florida. I yield.

Mr. DONDERO. Is there anything in this program that deals with the question of synthetic rubber as a by-product from coal?

Mr. PETERSON of Florida. The gentleman from West Virginia will develop the whole situation during the course of his statement. He has made a complete technical investigation of the subject as chairman of the subcommittee and I had intended for him to handle the debate on our side.

Mr. Chairman, at this time I yield to the distinguished gentleman from West Virginia who deserves such a large share of credit for this far-sighted measure, 20 minutes, and whose hard work, untiring energy, and close attention to this important subject deserves the praise of the whole Nation.

Mr. RANDOLPH. Mr. Chairman, the legislation which comes before us this afternoon for consideration by the committee, and which we trust will receive the unanimous approval of the House, is the result of approximately 1 year and 9 months of study by the House Committee on Mines and Mining.

In April 1942 the distinguished chairman of that committee, the gentleman from West Virginia [Mr. SMITH] appointed a subcommittee to study the necessity and feasibility of developing in this country a synthetic fuel industry to take care of the impact of war and the needs which would come in the mechanized era in which we would find ourselves at the conclusion of the conflict. The initial hearings were held in June of 1942.

In August 1943 the subcommittee of the House Committee on Mines and Mining joined a subcommittee of the Public Lands Committee of the Senate, in exhaustive hearings. The Senate subcommittee was under the very splendid leadership of the legislator from Wyoming, Senator O'MAHONEY. He had introduced S. 1243 to cope with this growing problem. We held hearings in Washington for a period of days, then journeyed to Pittsburgh for hearings and an investigation of the laboratory at the United States Bureau of Mines experimental station, and from there we went to Salt Lake City, Utah. There ended very fruitful discussions and exhaustive consideration of this legislation at Cheyenne, Wyo., on August 11, 1943. More than 450 pages of informative testimony was assembled and has been printed.

At this point I wish to express my genuine appreciation for the unfailing courtesy which Senator O'MAHONEY extended. I desire also to thank the members of the House Mines and Mining Committee for the cooperation displayed in solidly supporting the provisions of H. R. 3209.

I am deeply appreciative of the attention which the House is giving to a proposal of this kind, and if I may be allowed without interruption, I shall present, step by step, what I believe to be the facts which will guide you in your action on this measure. If I could not stand in the well of the House this afternoon and approach the necessity for this legislation, built on fact alone, I would not care to participate in the debate on this bill.

What is the present rate of crude-oil production in the United States?

We find that in 1943 it was about 1,500,000,000 barrels. This was an all-time record. But the estimated demand for 1944 is even greater, or over 1,600,000,000 barrels.

Will oil consumption decrease or increase after the war?

Certainly the country could reduce its demand to almost any level by sufficient restrictive legislation, but the people of the United States do not want that and I am sure Members of Congress would not desire it. In time of peace it would be unnecessary. It would restrict our development, lower our standard of living, and create unemployment.

During 1941, which was a reasonably prosperous year and before we were at war, for at least 11 months, our consumption was over 1,250,000,000 barrels annually. After the war it is believed we will have one-third more automobiles, private aviation will increase tenfold, commercial air transport to perhaps an even greater extent, and our system of highways will be vastly extended. This House received a report only a few weeks ago in which a program was advanced to build 34,000 miles of express roads in this country. Of course, we know there will be economies in engine performance and we know that it will tax the ingenuity of our engineers to make these balance new and increased uses. It is reasonable to believe that our vast war demands will fall off, but when they do they will be replaced and perhaps extended by a civilian demand.

I wish to call your attention to a report recently made by General Arnold, in charge of our Army Air Forces. He points out that since Pearl Harbor the Army Air Force alone has consumed more than 2,000,000,000 gallons of high-octane gasoline. Breaking this down, we realize that is more than 200,000 railroad tank cars. This is but one drastic drain on the domestic petroleum pools of this country under the mechanization of this global conflict.

If we believe in the future of our country, if we plan for a full level of employment, we should equally as well lay our plans to provide the oil and gasoline that such conditions will certainly demand.

Let us go into the matter of how much oil is being discovered in new fields in the United States each year. Since 1937 the oil discovered in new fields has been less than our consumption. This deficiency occurs year by year. In 1937 we produced three-quarters of our annual consumption by the discovery of new fields, yet that gradually came down year by year, until in 1943 we discovered only one-fourth of the oil which we were consuming.

Oil in new fields as a fraction of annual consumption

Year:	
1937-----	3/4
1938-----	2/3
1939-----	1/3
1940-----	1/4
1941-----	1/3
1942-----	1/4
1943-----	1/4

In the last 4 years we have discovered in new fields only about one-fourth of the oil we have used.

In this connection I believe it is interesting to direct your thinking to this fact: Even taking into account an annual upward revision of oil reserves in known fields, production has exceeded discoveries for the past 5 years. During 1942 and continuing into 1943, the total

discoveries of reserve oil from new pools and from revaluation of old fields were near the lowest level in the history of the oil industry since 1918. This is in the face of the highest consumption of oil products on record.

It might be asked, Does this failure to discover new oil result from a lack of exploratory drilling and wildcatting, owing to the shortage of materials and manpower? I answer emphatically no; it does not. In 1942 we drilled exploratory wells to the number of 3,300 and in 1943 we had approximately 3,400 wells that were of an exploratory nature. These years represent, contrary to popular belief, the highest number of wildcat wells drilled in the United States, but these wells did not discover oil at the rate the United States was consuming it. While it is comforting to think that an even greater exploratory effort may increase our discoveries, there is no assurance that that is true. In fact, the very intensity of this effort makes each new field more difficult to discover. These circumstances make for a future decrease in discoveries fully as likely as an increase. The effect of each new field discovered means one less to discover.

Someone might ask, Is the low rate of discovery of these new oil reserves due to failure to locate new pools? I would reply that it is not. As a result of our great exploratory effort, the number of new fields has increased, but each one is small compared with the great fields that had previously been discovered.

I have a table which discloses clearly that the drilling of more wildcat wells to find new pools of petroleum does not solve the problem because the shortage continues, due to the fact that the amounts found are relatively small.

Year	Number of new fields	Average volume of petroleum reserves per field
		Barrels
1936.....	162	14,771,000
1937.....	221	9,399,000
1938.....	256	8,980,000
1939.....	254	3,215,000
1940.....	304	4,515,000
1941.....	341	2,863,000
1942.....	348	1,458,000
1943.....	1500	(²)

¹ Estimate.

² Volume of petroleum reserves per field not yet determined. Preliminary estimates indicate that it will be almost the same as for 1942.

Those figures indicate the seriousness of the situation. No thinking American, anxious for his country's well-being, can hesitate in aiding a sensible program for synthetic fuel production to aid in keeping this Nation the No. 1 transportation country of the world. Also, we must be ready to meet an emergency which can arise, greater than that we now face. No one can with certainty indicate what day this terrible war will end. But we do know now, not later, that we have explored for new fields, we have done intensive drilling, yet the results from discoveries show a very drastic decrease in the reserves which have been found.

Mr. LANHAM. Will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from Texas.

Mr. LANHAM. May I say to my friend that I think his statement should be amplified to this effect: One reason there has not been a greater discovery has been because the price of crude oil has been so low that those interested in the oil industry have not been willing to undergo the expense of drilling to the deeper pools and a great many of the oil experts in this country are of the opinion that 90 percent of our available petroleum through such drilling is still untapped. We passed in this House, as the gentleman knows, a bill seeking to raise the price of crude oil in order that we might increase our production of petroleum. That bill is now pending in another body. In view of the acuteness of our petroleum situation and in view of our desire to foster private industry, I hope insofar as it is possible that that bill will soon pass and be approved.

May I ask the gentleman this question while I am on my feet: As I understand, it is the purpose of this measure not to get the Government into the oil business but through experimentation to seek other sources of oil in order that such business of this character as may be available could be turned over to private operation.

Mr. RANDOLPH. The gentleman from Texas makes two observations which are correct. The first is that we need to raise the price of oil to stimulate wildcatting. I voted for that measure, and trust the Senate will act affirmatively on it. I believe it to be a necessary stimulant.

I am glad also that the gentleman has gone into the subject of private business and Government cooperation. Under the provisions of this bill the Government of the United States is not entering into business in competition with private industry. We have placed restrictive language in the measure to cover that point. We know that in our hearings the oil industry, through the independents and the organized companies, were enthusiastic for this type of legislation, because they believed that the Government could lay down a pattern which they, very quickly perhaps, could follow and take over as a private enterprise. This is highly desirable. We want only to lead the way at a time when congressional foresight is needed.

Mr. LANHAM. If the gentleman will yield further, it is my understanding that the plants contemplated are to be very small, the maximum production to be not more than 1,000 barrels a day, and that the entire proposal is for experimentation to make this available to the operation of private industry.

Mr. RANDOLPH. The gentleman is correct when he mentioned 1,000 barrels a day. Really, that is the top. Perhaps 500 barrels would more nearly coincide with the thinking of the research experts of the Bureau of Mines.

This decrease which I have read in reserves per field to one-tenth of the value found in 1936, over a period of the last 6 or 7 years, we believe to be alarming. That is why the committee brings this measure here today. The oil industry, we know, are drilling now where they think the prospects for finding oil

are best. If they do not find oil, it can only mean that their scientists, their geologists, are approaching perhaps an end of the resources, and it is likely that they are seeking something that is not there.

There are some who will tell you that we cannot sit in Washington and find oil, and that it is only necessary to explore and it will be found. We say to those persons that the oil companies themselves are spending millions of dollars annually on this effort, that they have hired the country's best brains, and all of this has failed to keep discovery equal or even close to consumption. We ask the question, What are the present resources of the United States in known reserves of petroleum? These are estimated at the present time to be 21,000,000,000 barrels.

Mr. SMITH of Ohio. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from Ohio.

Mr. SMITH of Ohio. Why cannot this be left to private industry?

Mr. RANDOLPH. Private industry has felt, as the hearings over many, many months indicate, that it did not feel that it could spend the amount of money necessary in learning the know-how to do this job. It felt, as was said by all the witnesses without exception, that the Government could do what has been done in Great Britain, that is, lead the way in a matter of this kind. We know that Great Britain controls provinces possessing great oil reserves, yet today 3,500 barrels of synthetic fuel are being produced in Great Britain in one plant which was established by the Government in cooperation with private industry, just as we hope to do it under this measure.

Mr. SMITH of Ohio. Will the gentleman tell me why this is not another Federal bureaucracy?

Mr. RANDOLPH. I think my voting record in Congress has been an independent one. I believe that if the gentleman from Ohio would scan it he would find that I have stood shoulder to shoulder with many others in attempting to do away with the overstaffing and the unnecessary agencies in our Federal system. However, I cannot understand how the gentleman would ascribe to the Congress of the United States a desire to continue bureaucracy when, in the face of a drastically dwindling petroleum supply, we attempt on a sound and sensible basis to lay a foundation which will enable us to produce domestically the liquid fuels and gasoline which we shall need in the years immediately ahead.

In further reply, may I say—advisedly—that prior to our entrance into the World War we were receiving our crude rubber supply from the Dutch and the British. I am not attempting now to criticize them, but I am saying to you that we paid the price they wanted us to pay, because we were under a monopoly to those sources of our supply of crude rubber. But when the war came and we found ourselves without any planning here at home for a synthetic rubber industry, this Congress, of which the gentleman is a hard-working Member, appropriated \$750,000,000 to build approx-

imately 59 plants to produce synthetic rubber in this country. We had to do that. It was under the impact of an emergency. But it is safe to say that we spent perhaps \$100,000,000 unnecessarily because we had to throw the program into high gear so quickly. We do not want that to happen again. That is why we bring here today a bill, unanimously reported, which we believe will set up a demonstration plant or plants and will lead the way to synthetic fuel development so that private industry, in a sense shaking hands with sound government, can give a basis for the products we must have in the future if we are to remain a first-rate power. We must have here, not abroad, the petroleum resources with which to fuel this era of wheels and wings in which America must be supreme.

Mr. DONDERO. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from Michigan.

Mr. DONDERO. The gentleman has touched on the question I asked the gentleman from Florida [Mr. PETERSON] a few minutes ago, that the backbone of Germany's war machine is the making of synthetic rubber out of coal or coal by-products.

The other question I wanted to ask is this. If we have 21,000,000,000 barrels of oil in reserve, I think it is fair to say to the House and to the country that it takes 25 or 30 years or more to get that amount of oil out of the ground. It cannot be done all in 1 year. I wish the gentleman would explain that fully to the country.

The CHAIRMAN. The time of the gentleman from West Virginia has expired.

Mr. PETERSON of Florida. Mr. Chairman, I yield 10 additional minutes to the gentleman from West Virginia.

Mr. RANDOLPH. I shall say in reply to the gentleman from Michigan that what he has said about Germany is correct. It took Germany approximately 20 years or a little more to develop a synthetic fuel industry. The same was true with its synthetic rubber research which led to such extensive development. Today more than 50 percent of the gasoline being used by the Germans in their war effort is coming from synthetic sources. We do not need to take that long in this country. We can do it perhaps in 3 or 4 or 5 years. But we do believe that now is the time to do it, when we see our resources being drained off very rapidly—to a danger point.

One bombing plane uses 1,000 gallons of high-octane gasoline on a mission, and a thousand of those bombing planes converge over an enemy target using 1,000,000 gallons of high-octane gasoline in a period of perhaps only 1 or 2 hours. It takes 4 gallons of crude oil to produce 1 gallon of 100-octane gasoline. So we can visualize the tremendous drain on, and the even greater demand for petroleum products, which will come as we go into the more crucial stages of this war.

Mr. DONDERO. I thank the gentleman for his very excellent statement on this subject.

Mr. CARTER. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from California.

Mr. CARTER. Has this bill been approved by the Bureau of the Budget?

Mr. RANDOLPH. The Bureau of the Budget has written a letter to the Secretary of the Interior under date of November 8, 1943, which incidentally was the day prior to the unanimous passage of similar legislation in the Senate. He set forth that it would not be desirable to take away critical materials from the war effort just at this time. No blanket approval of doing the job exactly now was given. This committee does not ask for that. In this bill we say "within the limits of critical materials available."

Mr. CARTER. As I understand it, it has not the approval of the Bureau of the Budget or of the President at the present time.

Mr. RANDOLPH. Not as an immediate construction program, but as a necessary full program to supplement known reserves it does have approval.

Mr. CARTER. If the gentleman has a letter approving it from the Bureau of the Budget I ask him to please put it into the RECORD.

Mr. RANDOLPH. I shall also include letters from the Petroleum Administrator for War, the Acting Secretary of the Interior, and the First Assistant Secretary, which I shall place in the RECORD.

PETROLEUM ADMINISTRATION FOR WAR,
Washington, D. C., November 8, 1943.
Hon. JENNINGS RANDOLPH,
House of Representatives.

MY DEAR MR. RANDOLPH: I am gratified to learn from your letter of October 25 that the Mines and Mining Committee of the House of Representatives has unanimously reported H. R. 3209 with amendments, which bill provides for the establishment and operation of demonstration plants for the production of gasoline and liquid fuels from coal and other substances. This brings us one step nearer the enactment of legislation which I consider essential to the fuel economy of the Nation. You are, of course, familiar with my endorsement of S. 1243, a Senate bill which is similar to H. R. 3209. I desire to repeat again my endorsement of this legislation.

It is quite true that we are faced with a shortage of crude oil supply. The discovery and development of new crude oil reserves has not kept pace with the mounting demands of the armed forces and essential civilian requirements for petroleum products. The cold hard facts indicate that by the end of 1944 we shall require the importation from foreign sources of approximately 300,000 barrels of crude oil daily to meet the projected demand for petroleum products at that time. Obviously, in the face of these facts, all possible steps should be taken to augment the Nation's petroleum supply. H. R. 3209 is a desirable step in that direction.

I am having an analysis made of the statements published by Mr. Leon Henderson in his broadcast of September 25 which you forwarded with your letter. You will hear further from me with respect to that matter.

Sincerely yours,
RALPH K. DAVIES,
Acting Petroleum Administrator for War.

THE SECRETARY OF THE INTERIOR,
Washington, D. C., October 27, 1943.
Hon. JOE L. SMITH,
Chairman, Committee on Mines and
Mining, House of Representatives.

MY DEAR MR. SMITH: You have asked my views on the provisions of H. R. 3209, a bill

authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

I am wholeheartedly in favor of the legislation proposed in the bill. It is high time that the country embarked in earnest upon the program of research and development work necessary to determine the processes and equipment required for the establishment of an industry which can help to supply the continuing needs of the country for liquid fuels which have heretofore been available from the ample but now waning domestic petroleum reserves.

The total demand for liquid fuel in 1941 and 1942 reached about 1,500,000,000 barrels annually. The rate of discovery of petroleum has decreased sharply since 1937. In the 3 years 1937-39, about 5,400,000,000 barrels were added to the Nation's proved oil reserves, whereas in the 3 years 1940-42 the increment was only 1,600,000,000 barrels. In 1942, the new reserves discovered, including extensions and new horizons in old fields, were at a low of 317,000,000 barrels or only about one-fifth of our annual rate of consumption. This failure to find adequate quantities of new oil was not due to lack of prospect drilling, as 3,264 wildcat wells were drilled in 1941 and 3,029 in 1942. The decline in the rate at which new discoveries are being made is causing serious concern as to a sufficient supply of crude petroleum in the event of a long war. The ominous implications of the progressive effect of this decline upon the peacetime economy of the post-war years are easily foreseen and can be effectively forestalled by timely action. The answer to the problem clearly lies in the utilization of other materials than petroleum as sources of the liquid fuels required to supply the Nation's needs.

It is apparent that this country can no longer delay in embarking upon a synthetic liquid-fuel program. Our study of petroleum reserves and the rate of their depletion indicates clearly that unless we take action, the end of the age of abundant oil is in sight. This development—and I fix no date for it—will inevitably bring major repercussions throughout our entire economy in peace as well as in war.

Fortunately, the Department of the Interior has been aware of these trends and has initiated the study of means which may still be taken to prevent the Nation from feeling the full force of future natural petroleum deficiencies. In particular, the Bureau of Mines has developed processes that actually have produced petroleum products and liquid fuels from coals, oil shale, gases, and other substances. We have also studied similar developments in other countries.

However, the time has come when we must get out of the test-tube stage into actual production. Past experiments have given us the scientific knowledge of the basic processes involved but the way must be blazed for American industry to enter this synthetic-fuel field, which inevitably will be one of the major industrial developments of the near future.

It is, in my opinion, the responsibility of an alert government to meet such a situation forthrightly. Therefore, I propose that the Government harness its facilities to the business of blazing this path so that industry and private initiative may take up the work. Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic-fuel production. Therefore, I propose that the Government fulfill its duty on a demonstration basis, making its findings and experience available to industry so that private enterprise can take up the task of providing syn-

thetic fuels on the scale necessary to safeguard the Nation's future.

In order to clarify the scope of the operations intended to be authorized by H. R. 3209, I recommend that the following language be inserted after the word "products" at page 2, line 2, of the bill:

"The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic-liquid-fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products."

The Department has not as yet been informed by the Bureau of the Budget concerning the relationship of this proposed legislation to the program of the President.

Sincerely yours,

ABE FORTAS,
Acting Secretary of the Interior.

UNITED STATES DEPARTMENT
OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D. C.

HON. JOE L. SMITH,
Chairman, Committee on Mines and Mining, House of Representatives.

MY DEAR MR. SMITH: In response to a request for immediate notification of any report by the Bureau of the Budget as to whether H. R. 3209 is within the President's program, I attach herewith a letter received today on that subject from the Director of the Budget. You will note that the Director concludes "that there would be no objection to the enactment of legislation authorizing this undertaking as a post-war project" and precedes this conclusion with the statement that "the construction of these plants during the present war should not be considered in accord with the program of the President."

H. R. 3209, as you recall, stipulates no time schedule in relationship with the war. The testimony of the Department, industry, and other officials was to the effect that any interference with the President's war program would be avoided, following passage of this authorization bill, by submission of priority requirements on material to the War Production Board, labor requirements to the War Manpower Commission, financial items to the Bureau of the Budget, and any other items to appropriate Federal agencies. This procedure would insure compliance with the changing requirements of the war program. Therefore, the concept of the Department, and the bill as written, would seem to be in accord with the stipulation of the Bureau of the Budget. The Department would not feel free to proceed with the essential preliminary work prerequisite to this large undertaking, unless definitive House action is taken on H. R. 3209.

Sincerely yours,

MICHAEL W. STRAUS,
First Assistant Secretary.

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D. C., November 8, 1943.
The honorable the SECRETARY OF THE INTERIOR.

MY DEAR MR. SECRETARY: Reference is made to prior correspondence concerning proposed legislation to authorize the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war and conserve and increase the oil resources of the Nation.

Your letter of October 25, 1943, indicates that you would contemplate the construction, under this legislation, of three plants, with a total investment cost of \$50,000,000, and with annual operating costs of \$7,810,-

000. In this connection, it is to be noted that the House bill, as reported to the House, fixes a total appropriation authorization of \$30,000,000.

Expert testimony before the subcommittee of the Committee on Public Lands and Surveys of the Senate indicated the contemplated program could not be looked upon as an important aid to the prosecution of the present war, or even to meeting the immediate post-war petroleum requirements. Moreover, the present construction of these plants would make considerable demand upon our supply of manpower and critical materials.

In view of these considerations, you are advised that legislation contemplating the construction of these plants during the present war should not be considered in accord with the program of the President, but that there would be no objection to the enactment of legislation authorizing this undertaking as a post-war project.

Very truly yours,

HAROLD D. SMITH,
Director.

MR. CARTER. There is another question that I want to ask the gentleman. The gentleman asks in this bill that there be authorized an appropriation of \$30,000,000. How was that figure arrived at?

MR. RANDOLPH. The men who have spent much time in an exhaustive study of this program, that is, experts of the United States Bureau of Mines, say that \$30,000,000 in their opinion will be sufficient to develop the methods by which we can do a good job in this country; perhaps it would allow for the construction of three plants. They will vary in cost, but they would cost in the neighborhood of \$30,000,000. One of those plants for demonstration purposes, of course, would be used in shale, possibly coal, and perhaps another substance. This is the figure arrived at by the men from the Bureau of Mines. We did not want to be excessive in our request. Just a few moments ago on the floor the distinguished chairman of the Committee on Naval Affairs, the gentleman from Georgia [Mr. VINSON] said to me that he hoped he would be able to come here and speak in favor of this legislation. He felt we should have at least \$100,000,000. I said to him that the experts felt that we could lay down a sound and workable pattern with this amount of money, and that is all your committee wanted to ask, and not a cent in excess of it.

MR. CARTER. Did the gentleman have testimony before the committee as to where the \$30,000,000 was to be spent?

MR. RANDOLPH. The testimony from the Bureau of Mines experts, which takes up page after page in our hearings, and in the joint hearings of the Senate and House, which go into the cost of the matter—

MR. CARTER. How many experimental plants can be built with the \$30,000,000?

MR. RANDOLPH. Approximately three.

MR. CARTER. And that means approximately \$10,000,000 for each plant. Where are they to be located?

MR. RANDOLPH. The Bureau of Mines would make the decision, and Dr. Sayers has suggested frankly to the committee that he and his associates would develop the facts before he located the

actual site, or sites, after the most careful study of the best places for the demonstration purposes.

MR. CARTER. Dr. Sayers and his staff carry on experimental work at the present time.

MR. RANDOLPH. Dr. Sayers and his staff, due to a small appropriation made by this Congress, which was fought 2 years ago, had the sum of approximately \$60,000, which they have used in a tiny, toy plant, a sort of laboratory, in Pittsburgh, at the experimental station of the United States Bureau of Mines. In August 1943, when the joint committee held hearings in Pittsburgh we saw that pygmy plant in operation and we felt that the results of their work indicated the need for demonstration plants of the size indicated in the legislation requested here today.

MR. CARTER. Have they reached any conclusion as to the result of that experiment work in Pittsburgh?

MR. RANDOLPH. They have reached some conclusions, and they urge plants of a larger size to develop these processes by which the cost of production of the synthetic liquid fuels can be reduced, and improved.

MR. JENKINS. Mr. Chairman, will the gentleman yield?

MR. RANDOLPH. Yes.

MR. JENKINS. Is it not true that the Bureau of Mines enjoys a splendid reputation for efficiency and high character in developments?

MR. RANDOLPH. I think so. The United States Bureau of Mines over a period of many years, through different administrations, has been composed of men, alert, scientific research men, who really are attacking this problem in a proper way.

MR. JENKINS. One of the things about this bill that recommended it to me very highly—and I could not have supported it unless they did—was the provision that the Bureau of Mines should have supervision over these things. My interest is this: This matter is not a matter of just new experimentation. Many plants have been built in Europe and other places, and even in the United States there are some struggling along trying to work out this problem, but the purpose of this program is to have the Government spend some money and in that way save private industry from wastefulness in trying to make experiments, which they cannot do without loss of time and money, and in this way if this experimentation is made under the Bureau of Mines, it will be complete in every detail; and that it is not the intention that the Government should go into this business of producing oil from coal—the Government does not want to do that and does not intend to do that, and there is no purpose to that—but it must be looked at something as the Congressional Library may be looked at. No city or State could afford a library such as the Library of Congress, but the Government in the interest of education can afford it, and the Government, therefore, in the interest of education in this case can afford to experiment and bring this matter up to a point where it is pos-

sible for private industry to take hold of it.

Mr. RANDOLPH. I think the gentleman is correct.

Mr. VURSELL. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. Yes.

Mr. VURSELL. I am for the principle of the bill. I think the legislation is proper, but one of the things that bothers me is that when we get into this synthetic rubber problem, and I believe the gentleman said there were something like 52 plants already constructed.

Mr. RANDOLPH. Fifty-nine.

Mr. VURSELL. At an expense of something like \$700,000,000, because we had to go at it rapidly. Perhaps I am wrong, but as I read the statements in the newspapers at the present time, the President and Mr. WALLACE do not want to continue making synthetic rubber from these plants, for fear they might have to charge a little higher, or that there might have to be a little subsidy granted. Are we getting into something here when he talk about synthetic rubber where we have an equipment already built, where perhaps we may find that under our good-neighbor policy we cannot afford to make synthetic rubber, but that we must keep ourselves bound to pay the unconscionable prices charged us by Britain, as the gentleman suggested? Just where are we in this synthetic rubber situation?

The CHAIRMAN. The time of the gentleman from West Virginia has again expired.

Mr. PETERSON of Florida. Mr. Chairman, I yield the gentleman 5 minutes more.

Mr. RANDOLPH. I wish to reply to the gentleman from Illinois [Mr. VURSELL]. I do not believe in the philosophy which would ditch these synthetic plants after the war just because we can purchase from outside. I believe that we are protecting domestic methods which are going to bring costs down to a considerable degree, and that the product will be good. In connection with synthetic fuel, we find, today, that from crude oil we are making gasoline at a cost of 5 cents a gallon; and from shale, which would be in the exploratory program, under the demonstration plants in this legislation, we find that we can produce it for from 7 to 12 cents a gallon; from tar-sands, at about 5 to 12 cents; from natural gas from 8 to 10 cents, under the Fischer process; and from coal under the Fischer process from 15 to 17 cents, and from coal under hydrogenation, at from 13 to 18 cents a gallon.

That shows us that the costs are now higher than the gasoline produced from petroleum. But we believe that by this type of sensible program we can produce the methods by which we can reduce the cost and bring into being in this country a domestic fuel program that can keep us from ever becoming an importing Nation from the standpoint of bringing in petroleum from other parts of the world.

Mr. BARRETT. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. I yield.

Mr. BARRETT. I want to compliment the gentleman on his splendid

presentation. That is precisely the reason why this bill will not put the Government in competition with private industry. It costs so much more to extract gasoline from shale and from coal than it does from petroleum that no private concern could possibly initiate experiments along this line. It is not the intention at all to compete with private industry, but solely to carry on these experiments and later on let private industry take hold and operate these plants after the policy has been well established.

Mr. RANDOLPH. The gentleman is correct. In section I of the bill we set forth:

The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

Mr. DISNEY. Mr. Chairman, will the gentleman yield?

Mr. RANDOLPH. I supported the gentleman's bill a few weeks ago and I am very happy to yield to him at this time, because he is a student of the subject of petroleum.

Mr. DISNEY. I was sure that I would be reminded of that when I rose to ask a question about the bill. The gentleman says that this \$30,000,000 is for the pattern. What will the complete picture consist of?

Mr. RANDOLPH. I do not think anyone can say, I reply to the gentleman from Oklahoma. Certainly we are not going to put the Government into this program except on the basis of coming through the Committee on Appropriations and making its case of not to exceed \$30,000,000. The United States Bureau of Mines says it will take that amount to place in operation the necessary plants to prove the practicability of construction and operation of a synthetic fuel industry in this country.

Mr. DISNEY. Is this a war measure?

Mr. RANDOLPH. I do not say you can exactly tie it into the war situation, although I will say this: I recall a speech last night by an official of the Government, a physician, to be exact, Dr. Ross McIntyre. He said we were thinking in terms of fighting another 3 years, at least, in the Japanese war. So I would hesitate, and I think any man is wrong in prophesying the war will end in a few months, or at any certain date. We do believe now, and not later, is the time to start on such a development as this. The petroleum industry, through those witnesses who came before us, believe that today and not later when we run into an acute emergency; not later when we have drained our petroleum pools, was the time to start on this program.

Mr. DISNEY. Were those witnesses in favor of this type of legislation?

Mr. RANDOLPH. They were. We had no opposition in all of the House or the joint Senate and House hearings. The petroleum industry, the independents,

and the organized companies, were unanimously in favor of the bill.

HOW LONG WILL THE OIL IN THE UNITED STATES LAST, BASED ON OUR PRESENT RATES OF DISCOVERY AND CONSUMPTION?

Contrary to popular belief, the country has an oil shortage right now. With our oil wells producing at rates which will avoid excessive loss of oil in the ground, we cannot secure enough oil to satisfy military and civilian demand. This is shown by the fact that our civilian restrictions are no longer attributed only to transportation or rubber shortages, but simply to the fact that we cannot safely withdraw oil faster from the wells.

Unless we can double or triple our present rate of discoveries, and there is no indication that we can, the shortage will grow worse year by year. The flush, high production of a well occurs in the first few years of its life and then falls off rapidly until finally only a few barrels a day can be withdrawn. At a low rate a well may continue to produce a little oil for 50 years. If an attempt is made to withdraw oil at a much higher rate the gas pressure driving the oil to the surface is lost rapidly and oil is lost in the sand in such a manner that it can never be recovered. With low discoveries the number of wells in flush production is growing smaller. Almost all of our production is coming from older fields whose production is decreasing rapidly. If we allow this situation to continue without taking vigorous and forthright steps to meet it, the country is facing a petroleum shortage of the most serious proportions by 1950.

OIL SHORTAGES HAVE BEEN PREDICTED BEFORE ON AT LEAST TWO OCCASIONS AND HAVE NOT MATERIALIZED. WHY IS THIS ONE ANY MORE LIKELY TO OCCUR THAN THE OTHERS?

From 1907 to 1910 there was a period in which unguided drilling of wells failed to locate very much oil and in a few quarters fear was expressed that the country was short of oil. This apprehension quickly subsided with the introduction of the simple surface geological methods which served to guide wildcat drilling and to increase discoveries. In 1923, 1924, and 1925, as shown in figure 1, total discoveries and consumption were about the same, and consumption actually exceeded discoveries slightly during 1924. This was followed by the application of new geophysical prospecting methods and from 1926 through 1931 tremendous reserves were discovered which abated fears of shortage. In 1932 and 1933 consumption exceeded discoveries but this was in a considerable measure a result of the depression as well as little apparent need for new oil because of the large reserves found in the immediately preceding years. Discoveries again greatly exceeded consumption from 1934 through 1938. There are two important things to note in these cases. First, there was no extended period in which production exceeded consumption and, second, during each apparent shortage new prospecting methods were developed that helped to solve the problem.

In contrast, the current shortage represents a period from 1939 through 1943

with total discoveries less than consumption for every one of these years. This is a much longer period than ever encountered heretofore where this highly adverse situation existed. Not only have discoveries fallen at an extraordinary rate, but this has been coupled with sharply increased consumption. No material improvement in prospecting methods has appeared during the last few years nor is any now in sight. Oil geologists are approaching the end of their resources so far as finding good prospects by present methods is concerned. In the past, fears of shortage have been based on what might happen; now they are based on what has happened since 1939.

Another interesting point brought out by figure 1 is the tremendously high discovery level that would have to be maintained to supply our economy at the rate oil was used for the pre-war year, 1941. For the 25 years, 1918 through 1942, there were only 9 in which discoveries exceeded this level of consumption and 16 in which they were less. To keep even, large fields must be discovered at periodic intervals such as represented by the years 1926 and 1930. The chances for doing this become less and less each year as the country exhausts its brightest prospects.

CAN AN OIL SHORTAGE BE MET BY OPENING UP THE WELLS AND LETTING THE OIL COME OUT FASTER?

Yes, for a short time, but this would cut our ultimate recovery of oil drastically for much of it remains trapped in the ground if withdrawal is too rapid. Such a policy could exhaust our entire reserve in 2 or 3 years. It must not be followed except in the most dire emergency.

Even with the high rates of withdrawal now in use, we are losing ground. In a report from the Interstate Oil Compact Commission (October 1943, p. 17) appeared the following statement:

It is alarming to note that after every available barrel of oil is produced from the presently known and developed oil fields of America, including the 246,000 additional barrels (per day) that can come from Texas, we still will be 500,000 barrels per day short of the anticipated demands at the peak of the 1944 estimates of crude-oil requirements.

WHAT CAN BE DONE TO MEET AN OIL SHORTAGE?

There are four ways to meet the oil shortage. The bill before us considers only one, but I want it understood that I favor the vigorous and active pursuit of all four.

The first way is to increase to the greatest possible extent our exploratory program and wildcat drilling. This can certainly be expected to help meet the shortage but will not solve it.

The second way is to import oil. In this case, we do not know how much the oil will cost, the amount we can secure, or whether it will be available to us through the vicissitudes of peace and war. Difficulties that may arise with oil from foreign sources is exemplified by problems presented in the production of oil in Mexico just before the present war started. Certainly no Member of Congress wants to entangle this country in controversy with foreign countries over oil supplies. If we do get in such an entanglement, we will need our own as-

sured sources of supply to support our economy and our Army and Navy.

The third way is to reduce consumption. So far as this involves more effective use of oil and more efficient motors, this is a sound program. I oppose the restriction of consumption, if it creates unemployment, retards our progress and development, and lowers our living standards.

The fourth way, is one that will assure the oil supplies we need, will help meet post-war employment problems, and in which the great majority of our States can participate. This is to make oil and gasoline from oil shale, coal, and lignite.

ARE THE PROCESSES FOR MAKING OIL FROM OIL SHALE, COAL, AND LIGNITE NEW LABORATORY SCHEMES THAT HAVE NEVER BEEN USED ON A LARGE SCALE?

No, they are not. Germany produces almost one-half the gasoline for this war from coal. England has one plant making 3,500 barrels a day from coal and coal tar.

DOES ANYONE IN THE UNITED STATES HAVE INFORMATION ON THE CONSTRUCTION AND OPERATION OF THESE PLANTS?

Yes; in spite of the fact that the Germans have kept the processes a military secret and have never released full information. The Bureau of Mines has sent engineers to Europe to obtain information and keep abreast of developments. Their last mission on this work was to England in June of 1943. They have also operated a small laboratory at Pittsburgh in which they have explored the secrets of the processes since 1936.

WHAT REMAINS TO BE DONE TO DEVELOP THESE PROCESSES TO COMMERCIAL USE?

These processes are in the laboratory stage in this country. They are in almost the same state as processes for making synthetic rubber before Pearl Harbor. To avoid a hectic, costly, and as yet unsatisfactory development, such as we are now witnessing for rubber, this bill, H. R. 3209, proposes that methods for making oil and gasoline should be brought to commercial usefulness before the country is caught in a damaging oil shortage. To do this, it is necessary to build a limited number of demonstration plants in which the chemical and engineering problems can be fully and carefully solved. The data from this work will allow industry to build plants of the most modern design, to secure the most efficient operation, and to produce gasoline at the lowest possible cost.

HOW MUCH WILL IT COST TO PRODUCE GASOLINE OR OIL BY THESE PROCESSES?

Raw materials that may be used to produce synthetic gasoline include natural gas, oil shale, bituminous coal, sub-bituminous coal, and lignite. The testimony offered at the hearings of Senate and House last summer on the companion bill (S. 1243) indicated costs ranging from 8.8 to 23 cents a gallon. This compares with about 6 cents a gallon from petroleum. The lowest price estimate was made by a vice president of the Standard Oil Development Co. and was based on the use of natural gas as a raw material.

The experts from the Bureau of Mines estimate that, in large plants compa-

rable to those used in the petroleum industry, gasoline can be produced from coal for about 15 or 16 cents a gallon. These are conservative estimates based on present known plant designs. Improvements in the processes as a result of the work under this bill can reduce these costs materially.

Crude oil from oil shale is estimated to cost from \$1.75 to \$2.50 per barrel. Petroleum varies greatly in price covering a range from around \$1 to nearly \$2. Oil from shale would be about 50 cents to \$1 more per barrel or from 1 to 2½ cents more per gallon.

CAN AVIATION GASOLINE BE PRODUCED BY THESE PROCESSES?

Yes, aviation gasoline is being produced from coal which in every respect is equal to gasoline from petroleum.

DOES THE UNITED STATES HAVE LARGE RESERVES OF OIL SHALE AND COAL?

Yes. There is sufficient oil shale to furnish all oil and gasoline at the present rate of use for 65 years. Oil shale is used for no other purpose, is now going to waste, but it can be made a valuable domestic raw material by enactment of this legislation.

There is sufficient coal to furnish all that is needed for heating and for all our synthetic liquid fuel for over 1,000 years.

IN WHAT STATES ARE THESE RAW MATERIALS LOCATED?

The majority of States have one or more of the raw materials, oil shale, coal, or lignite, and can participate in the program planned under this bill.

HAS PUBLIC TESTIMONY SUPPORTED THIS LEGISLATION?

Hearings on the Senate bill were held last August in Washington, Pittsburgh, Salt Lake City, and Sheridan, Wyo. Testimony was presented by 77 witnesses. This legislation was actively supported by oil companies, coal companies, and their engineering and research organizations. A representative from the Army testified to the need for the work. State officials and representatives from State universities pointed out that the program was of national interest. Industrial organizations and Government officials offered testimony supporting the program. These hearings revealed strong sentiment favoring the proposal in all regions of the country.

WHAT WILL HAPPEN TO PATENTS DEVELOPED AS A RESULT OF THIS WORK?

They will be assigned to the Government and will not be the property of individuals.

WILL THIS LEGISLATION HELP TO SOLVE OUR POST-WAR EMPLOYMENT PROBLEMS?

It will—by opening a whole new chemical field for development by industry. It will furnish work for our construction companies, our steel companies, and will employ many miners.

WILL FUNDS WHICH ARE PROVIDED BY SUBSEQUENT ACT OF CONGRESS IN CONNECTION WITH THIS LEGISLATION BE SPENT IN THE UNITED STATES?

Yes, they will. This money will be used for our benefit in our country.

The CHAIRMAN. The time of the gentleman has again expired.

Mr. PETERSON of Florida. Mr. Chairman, I yield 5 minutes to the gentleman from Arizona [Mr. MURDOCK].

Mr. MURDOCK. Mr. Chairman, I have been a member of the subcommittee making this study. I feel that the chairman of the subcommittee, the gentleman from West Virginia, has done a very good job dealing with the scientific phase of this, even going into details. So I will deal with quite another matter. I sat here earlier in the day and listened to a conversation between my chairman and the chairman of the Committee on Naval Affairs, the gentleman from Georgia, who declared that in his judgment this is one of the most significant bills presented to this Congress for many years. And although I am naturally interested in it I think I see why this is so vital.

Now I take from my pocket a coin on which there is inscribed a Latin phrase, a very significant phrase in American history, *e pluribus unum*. I tell you, gentlemen, that historically is a significant phrase; when we consider that out of many States and communities we now have one united nation. Who was it that wrote *e pluribus unum* across our seal, across our coins, and across the course of our history? Of course, you gentlemen of the bar would say at once it was a group of men back yonder in Philadelphia in the summer of 1787 who wrote the Constitution of the United States, who provided thus for a more perfect union, and who consolidated these States into one nation. I agree largely with you in that, but I recall that on a summer day in 1787 a shabbily dressed man appeared before the old philosopher, Dr. Benjamin Franklin, and said, "Dr. Franklin, will you come down to the river this afternoon to watch my experiment?" And old Dr. Franklin, being in advanced years and suffering somewhat with an ailment, said, "Well, I am afraid I cannot get down to the river to watch your experiment. I wish you well." Franklin was himself both a solon and a scientist.

I want to say to you that the gentlemen who met in that famous Convention in 1787 did adjourn from Independence Hall, and from their labors and they went down to the bank of the river to watch an experiment. They saw something which was destined to play a great part in the unification of America. That experiment was the application of steam to the propulsion of a steamboat. I want to tell you gentlemen, as a student of American history, it is difficult to determine who had most to do in writing "*E pluribus unum*" from the Atlantic to the Pacific in the creation of these United States of America; whether the men who wrote the Constitution or whether the men who made possible rapid transportation by steam on land and water.

On November 6 last I went out to the Washington Airport to see my friend the gentleman from West Virginia arrive on a plane. I think a lot of my good friend from West Virginia, the chairman of this subcommittee, but I would not ordinarily have gone out there that day, what with the bad weather, just to see him fly in. This was no ordinary occasion. The point was that the gentleman from West Virginia, from a place 175 miles

distant, flew a plane into Washington for the first time with fuel made from coal. I tell you that was a very significant thing. That was history in the making.

All of us have had pointed out how our dwindling reserves of petroleum are leaving us in great straits. I feel if we are going to conduct a long war on a global scale and later on carry on commerce throughout the world on a global scale, and are not to ditch all our internal combustion engines, we are going to have to get another source of fuel for power. It is the exploratory work which this bill makes possible. I will not take the time from other gentlemen who have these details more at hand, but I want to point out that this measure taps new sources of fuel, not only for internal combustion engines needed for rapid travel, but also for commerce. It means smokeless fuel for homes and factories. I think if we create three great laboratories we will be able to do this exploratory work.

The CHAIRMAN. The time of the gentleman has again expired.

Mr. PETERSON of Florida. Mr. Chairman, I yield 1 more minute to the gentleman from Arizona.

Mr. MURDOCK. I feel, after listening to all of the testimony that has gone into these hearings and seeing what they have done in Germany and Russia, as well as in England and other countries, that we can make use of some of these formulas which are now in our possession, or at least German formulas in the possession of the Alien Property Custodian, and that we can get the know-how very soon so that American business, having found out the best that the scientific minds of this country can determine, will furnish this power.

The gentleman from Oklahoma asked, "How much is it going to cost?" Well, \$30,000,000 will be what the Government will put up in developing the processes and then the cost of ten or twenty times that much will be put up by private individuals and private companies to exploit this process or these processes to the full.

I am in favor of this bill and hope it passes unanimously.

The CHAIRMAN. The time of the gentleman has again expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield myself 5 minutes.

Mr. Chairman, I doubt that there is anything I can add to the splendid presentation made by the chairman of our subcommittee, the gentleman from West Virginia [Mr. RANDOLPH], who has made a very, very careful study of this entire and most important matter.

I do want to point out, however, with respect to the matter of cost, this fact: At the time our committee was meeting jointly with a committee of the Senate it was thought on the other side of the Capitol, that perhaps Congress would be fully justified in appropriating \$100,000,000 to conduct these very important studies, to put us in better position to safeguard our future against possible complete dwindling of our known reserves of oil. The committee on this side of the Capitol insisted upon a re-

duction to \$30,000,000 for this purpose.

Mr. Chairman, there are many other Members on this side who are anxious to discuss this matter because it is a matter that is very important to their districts, being coal-producing areas. I shall yield my time to them. However, I do want to point out that this bill specifically provides that this experimental work will be conducted by the Bureau of Mines. The Bureau of Mines, as has been aptly said by the chairman of the subcommittee, is highly regarded by the coal industry. I have talked to representatives of the coal industry and they are thoroughly in accord with the purposes of this bill. They sincerely hope and expect that this legislation will be passed.

Mr. RANDOLPH. Will the gentleman yield?

Mr. BRADLEY of Michigan. I yield.

Mr. RANDOLPH. There are 28 States in the Union that have coal deposits and there are about 12 States that have shale deposits. We want it clearly understood that there is nothing sectional in this type of legislation. It is an over-all planning for the country. We can make approximately 125 gallons of gasoline from 1 ton of coal. That varies with the type of coal used. We can make approximately 35 gallons of gasoline from a ton of shale, although we can go up as high as 75 or 80 gallons in certain parts of the country.

Mr. BRADLEY of Michigan. Depending upon the oil content of the shale.

Mr. HOWELL. Mr. Chairman, will the gentleman yield?

Mr. BRADLEY of Michigan. I yield.

Mr. HOWELL. Not only as a new source of fuel, but as possible relief for unemployment, this bill seems to have particular significance. In my particular district in Illinois and throughout other sections of the State when the demand for coal slackens those mines are forced to close, and unemployment ensues. It seems to me that this bill is particularly significant as possible relief from unemployment which will necessarily follow a decrease or slackening of the demand for coal, due to the war.

Mr. BRADLEY of Michigan. Of course, the purposes of this bill are purely exploratory, but I agree with the gentleman that after the know-how has been developed, should private industry then take up and capitalize on the results of these studies, it should have a very stabilizing influence on the entire coal industry and tend to stabilize employment in the industry, because certainly in the post-war world we are going to have an increased demand for petroleum products or for liquid fuel.

Mr. Chairman, I ask unanimous consent to revise and extend my remarks and I yield back the balance of my time.

The CHAIRMAN. Without objection, it is so ordered.

There was no objection.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from Ohio [Mr. SMITH].

Mr. SMITH of Ohio. Mr. Chairman, I ask unanimous consent to revise and extend my remarks.

The CHAIRMAN. Without objection, it is so ordered.

There was no objection.

Mr. SMITH of Ohio. Mr. Chairman, first I should like to ask the gentleman from West Virginia [Mr. RANDOLPH] who has this bill in charge, whether I understood him correctly. Did the gentleman say that this program could not be of value to the war effort?

Mr. RANDOLPH. I might answer in this way: If the war continues for a period of years, we think it definitely will be needed as a further supply for petroleum products. If the war should cease in 1 or 2 or 3 years, we would have had during that period of time such terrific drains upon our petroleum pools that this program contemplated would give us one further method in our own country—not in the Mediterranean, not in the Persian Gulf, but here at home, where we would have sensibly laid down a foundation that we could carry on through private industry in the development of the synthetic-fuel industry. I have not answered the gentleman perhaps. I can only say that no one can say when the war will end. The gentleman would not hazard a guess, nor would I. But we have stated in the bill that the program would go forward within the limits of critical materials available.

Mr. SMITH of Ohio. I understood the gentleman also to say that it would take about 4 years to put this program through the experimental stage where the results would be evident. Is that correct?

Mr. RANDOLPH. Yes; 3 to 4 years are the best estimates of the Bureau of Mines and other research men from private industry who appeared at the hearings.

Mr. SMITH of Ohio. Now, I have tried in every instance to support legislation which was necessary to carry on the war. I have two sons in this war. I think I have as much interest in winning it as quickly as possible as any Member in this House. But so many of these propositions come before this Congress as war measures which appear to me not to be such.

We are making a great fuss about bureaucracy. We want to see private industry saved in this country. We are starting another bureaucracy here. There is no question in my mind about that.

Mr. HINSHAW. Mr. Chairman, will the gentleman yield to me?

Mr. SMITH of Ohio. I yield to the gentleman.

Mr. HINSHAW. I would like to call the gentleman's attention to the fact that in future wars, which we certainly must look out for and hope against, it will be necessary again to use large supplies of fuel oil for battleships. It might become necessary for us to set aside certain of our reserves and hold them against that time. It might be that by the conclusion of this war we would have very little expendable reserves for civilian uses.

Mr. SMITH of Ohio. Now, I agree with all that the gentleman has said, but I want to call the attention of this House to this fact, that this war is being fought with the fruits of private endeavor and

industry. This war is going to be won with those fruits.

The CHAIRMAN. The time of the gentleman from Ohio has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield the gentleman 1 additional minute.

Mr. SMITH of Ohio. The difference between our views on this question is this: I have faith in free enterprise. I still have faith in human liberty. If private enterprise is able to do this war job as it is certainly doing, I am willing to continue to put my faith and trust in private industry.

Let me say this in conclusion, that these political machines—and that is all this is, once set up never operate the way we intend them to operate.

The CHAIRMAN. The time of the gentleman from Ohio has again expired.

(Mr. HOWELL asked and was given permission to revise and extend his own remarks.)

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from Ohio [Mr. JENKINS].

Mr. JENKINS. Mr. Chairman, I should like to say a few words in regard to the statement made by my distinguished colleague from Ohio [Mr. SMITH]. At the outset let me say that there is no man on this floor who is more zealous, more studious, more sincere in his efforts than the gentleman from Ohio. If I had the same views he has concerning some aspects of this bill I think I would oppose it. If I could not agree with any of its purposes at all I would, of course, be against the bill. But I want to assure the gentleman that private industry appeared before the committee that has charge of the passage of the measure, and private industry has indicated that they want this legislation because as I said in some remarks that I have heretofore made that these experiments cannot be carried on by private industry alone by themselves. They want and need the encouragement they know they can get by the great departments of the Government cooperating together and with them. I want to say to him further that this legislation we are trying to pass here today has been given a tremendous impetus by reason of the war. Some of us for years have been in favor of this legislation but we have not made much headway at times, other things would intervene; but since the war this bill has been almost unanimously favored. The coal people are favoring it and the oil people are not opposing it, and the scientific people are not opposing it. They are for it because they appreciate what will happen to us if we should have such a terrific drain on our oil reserves as we have had during the last 5 years. We could not stand it.

I am going to place in the RECORD after the committee rise and I can get permission in the House, a very comprehensive study made by Dr. MacQuigg, dean of the Engineering College of Ohio State University. He is one of the best posted men on this subject in America.

Mr. BRADLEY of Michigan. Mr. Chairman, will the gentleman yield?

Mr. JENKINS. Yes, I yield to my friend from Michigan.

Mr. BRADLEY of Michigan. May I say to my distinguished colleague from Ohio that our subcommittee and the full committee also are unanimously for this bill. We think it is very much needed and very timely legislation.

Mr. JENKINS. It has no politics in it and it has no sectionalism in it. Personally I am not sure that three plants will be built; in fact I doubt if they build more than one at first; I do not think they will spend the entire \$30,000,000. My guess is that they will not spend more than \$10,000,000 at first. My judgment is that they may not conduct their experiments in the big coal fields that are well developed now but may go into States like Wyoming where they have a grade of coal they cannot ship, that will not stand the weather, that will not stick together in freezing weather; they cannot ship it because it jars to pieces. I do not say that all Wyoming coal is of that grade, but some of it is, and some of that kind is high in qualities desirable for this work. I see my distinguished friend from Wyoming ready to rise in defense of his State. I know that his State contains a great quantity of fine coal. But naturally I could not concede to him that his coal stands in the same class as coal in my State. Possibly they may put one of these plants out there in his State, if that will satisfy him, and his coal might be found the ideal coal for this purpose. But leaving facetiousness aside, there are many large deposits of cheap coal all over the country that can be used.

Mr. CHENOWETH. Mr. Chairman, if the gentleman will yield, I will remind him that we have coal in Colorado, too.

Mr. JENKINS. The gentleman speaks of there being coal in Colorado. Yes; the great State of Colorado also has some excellent shales that may be desirable for this purpose.

I am supporting this measure and ask you to support this because it is meritorious. I want it understood, Mr. Chairman, by my colleagues, that this is not a measure that will benefit any one section especially and is not promoted by anyone who comes from the big coal districts. This is a tremendously important measure. If it is successful who knows how far-reaching it will be. We have an inexhaustible supply of coal available. Alaska, which is practically untouched, has great coal fields. If this will be successful it is time we find it out. If it is not successful it is likewise time we find it out.

Another reason why I support this legislation is because the general process of making oil from coal has been approved scientifically at many different places. What is needed is that all these previous experimentations be studied carefully and an effort be made to give to our people the facts. If these facts justify our further pressing the matter we should do so. If not we shall have put at rest all this agitation and thereby save many expensive experiments by private capital. As far as the expense is concerned it is a very small item compared to what we are spending in other directions on matters that are of no comparable consequence. I want the House to understand that in my opinion

this whole program has passed, what we might term, the experimental stage. It is not a new field at all. It is an effort to capitalize on the experimentations of Germany, Great Britain, and other countries so that when we go into this business we will not pay for mistakes; we will know what mistakes have been made and we can start at an advanced stage, but those engaged in private industry in this business will of course continue these experiments.

Mr. Chairman, I have already referred to Dr. Ellison MacQuigg, the dean of the school of engineering at the Ohio State University. He has made many exhaustive studies of this subject. Under his direction the school of engineering at Ohio State University has made many scientific demonstrations. He is one of America's great chemical engineers. And besides being a great scientist he has the distinction of having been born and brought up in my home town of Ironton, Ohio, where we are proud of his achievements.

I am glad to insert at this point a very scholarly and lucid statement made by Dr. MacQuigg on this subject. I commend this statement to the membership of the House. It is written in plain understandable language and free from technical terms.

STATEMENT BY C. E. MACQUIGG, DEAN OF THE COLLEGE OF ENGINEERING OF THE OHIO STATE UNIVERSITY, COLUMBUS, OHIO

The following reasons may be cited for the enactment of bill S. 1243:

1. IMPENDING SHORTAGES OF LIQUID AND GASEOUS FUELS

Enough reliable information has been accumulated to indicate that the known reserves of petroleum and natural gas in the United States are so limited in extent when compared with our present consumption that in the not distant future our consumption will be of such relation to the reserves as to require other sources of supply much sooner than has heretofore been the general belief.¹ Some authorities have placed this time of the catching up of rate of current use versus developing reserves, as low as 13 to 15 years; others decline to name a definite time, but admit its relative nearness. Still other persons decline to admit an impending scarcity of petroleum and natural gas and hopefully postpone shortages to an indefinite, long future; the latter group of experts are undoubtedly in the minority. It is not necessary for the present consideration to know definitely what the exact life of the reserves will be. One of the latest statements on this subject is that made by Dr. B. T. Brooks in the New York Times of Sunday, July 18. The gist of Dr. Brooks' statement is that the United States will become an oil-importing nation before long. Suffice it to say that whether the period be 10 years, or 50, the validity of the argument developed here is unaffected.

It might appear from the indefiniteness of the life of the reserves that this question is not of immediate concern and at the very worst many years of plenty remain to us respecting our supplies of petroleum and gas. Be this as it may, the arguments presented herein are based entirely upon the fact that the reserves of coal are many hundreds of times greater than the reserves of liquid and gaseous fuels and that sooner or later we must proceed to replace the latter fuels by the former. Proceeding with the picture of the inevitability of eventually deriving our

liquid and gaseous fuels from coal, we can justify an experimental plant for research purposes alone. It will be shown, however, that such a plant in certain areas, can reasonably be expected to have utilitarian purposes of wide consequence to its surrounding communities. Admitting at once the lack of commercial feasibility for the products of the plant at present prices for hydrocarbons, nevertheless, we shall try to demonstrate that no time should be permitted to elapse before large scale research is started on our American coals.

Our economic life is definitely built, to a great extent, on the internal combustion engine, and it is, therefore, trite to point out the increasing dependence of Diesel-driven marine and land transportation on gasoline and the heavier liquid fuels; also motor-driven equipment is a *sine qua non* of military matériel, while the necessary control of the air is dependent upon an ample supply of high octane gasoline.

Turning to the post-war economy, it is not any longer a matter of speculation as to what our fuels will be. Much of the mechanical energy needed for our national life will be derived from liquid and gaseous fuels. If in a relatively few years our liquid and gaseous fuels supplies give us increasing concern, it is logical that we must not longer delay planning to use our scientific knowledge for the solution of our problems. It seems self-evident then that we can follow one of very few courses. We can continue to deplete our natural supplies yet remaining in the earth and, in the case of natural gas, continue to regard it only as a fuel instead of a God-given chemical agent, and do nothing to develop technology along clearly indicated lines. Such a course will hasten the day when we must perforce import fuels. On the other hand, we may produce substitutes for natural gas and petroleum. Happily coal can be transformed to liquid and gaseous fuels and for an indefinite future we must rely upon coal.

2. RESEARCH MUST BE DONE NOW

The processes contemplated for further development under sponsorship of this bill—such as coal hydrogenation or gasification through the "water gas" types of reactions are not in controversy as to their technical feasibility. Vast plants are being operated abroad at this moment for the production of gasoline and other valuable hydrocarbons. What is being proposed for the United States is a concrete study of the applications of the established technology to our own engineering economics and study of further refinements. By constructing the proposed experimental facilities we will, as a Nation, be in a better position to cope with the shortage of certain kinds of fuels, notably petroleum and gas, through the conversion or substitution of our most plentiful form of energy, namely, coal. This substitution, even at increased cost, sooner or later is going to be necessary and justifiable on the basis of our economic situation in which we are already fixed.

As the matter stands today our technicians are somewhat familiar with the details of foreign practices in this art. They do not, however, know the necessary facts relative to the behavior of our numerous types of American coals and the many factors necessary for commercial development by these methods.

3. THIS PROJECT MUST BE GOVERNMENT-SPONSORED

Ordinarily, industrial research gambles with some process which is as yet only envisioned or, at best, merely discovered and not at the time fully commercialized. In the present situation the uncertainties attendant upon the usual pattern of industrial research are largely removed because large-scale operations abroad have already demonstrated the entire practicability of the

processes; one plant alone in England is producing thousands of barrels of gasoline per day. Therefore, with the removal of the hazards accompanying the average industrial research, this is not a research gamble but a problem in the application of known methods to the solution of questions in our national fuel economy. Moreover, the establishment of this plant would differ from the customary type of industrial development where the element of gain is quite properly present in the financial return to the company or section of industry. The proposed project concerns the welfare of the Nation and is not in the same category as the development of a process whereby a single interest may benefit.

It might be argued that an experimental plant of the type mentioned should be the concern of one of the large American industrial organizations—say a coal association, or a large producer of petroleum products, or a manufacturer of organic chemicals, or some similar industrial interest or group of interests. Such is not the case, because of several factors applying to this specific situation. In the first place, it may well be argued that the cost is too great for any single commercial interest in view of the diffuse nature of the rewards to be reaped in the future by any one interest alone. Since no basic patent protection could be enjoyed, the monetary reward for development by a single company would not be attractive enough in the immediate future to justify the required large expenditure of stockholders' money. Moreover, since the matters to be investigated are so fundamental to the well-being of our national life, it would seem that automatically the problem goes into the domain of the General Government.

If it should be argued that the time element does not press for the immediate development of this plant, such argument may be answered by stating that an experimental plant can be justified as a military necessity. Already we are vexed by the very problems touching the heart of these researches, namely, gas and oil shortage. With a short war the temporary dislocation of civilian life with attendant problems of morale can be postponed for a period; with a long war not only is the civilian situation aggravated, but matters of military necessity become infinitely sharper. Chiefly due to transportation difficulties, we are now tasting a situation which, in the not distant future, may well be due to an entirely different cause, namely, scarcity of supply.

4. COLLATERAL ADVANTAGES OF A RESEARCH PLANT

Compelling reasons in related realms of national welfare justify the immediate conduct of the proposed researches. Among these are the wide social implications beyond the obtaining of technical data on the processes. For example, in certain areas of the Appalachian coal fields, the local deposits suffer in competition with the coals of adjoining regions because of characteristics of composition. This results in the unemployment of the miners with attendant lowering of the economic standards in the whole district. (No problem exists in marketing the high-class coals which should be used as they are; the beneficiation of the less marketable fuel is needed.)

These coal deposits are merely awaiting the touch of processes which will make them available and at the same time capitalize on the acute needs for the more desirable types of fuel. As an example of what is meant: We have a certain combination of factors in our area which have been of concern to the Ohio State Engineering Experiment Station. The western fringe of the Appalachian area presents a unique combination of problems; because of the importance of this area from the standpoint of population, war production, tax-paying capacity, and other physi-

¹ Coals' New Horizons, Coal Age, April 1943, p. 57.

cal and economic factors, it is almost the solar plexus of the Nation. Some of the reasons why this research is timely for this area are, very briefly: (a) the availability in Ohio alone of some 5,430,000,000 tons of coal reserves² with an already developed producing capacity of thirty to forty million tons of coal per annum. Details of the location and composition of this coal are presented in the accompanying report.³ (b) This area, being the first to develop natural gas, has come to depend heavily on that source of energy for both industrial and domestic use.

Because it is such a large consumer of natural gas, exceptional facilities for distribution of this fuel have been set up. Threatened now with shortages, this area becomes strategically most important in connection with the proposed treatment of coals. Numerous benefits can be visualized by switching from coal to derived products; one among them is combating the smoke nuisance in the exceptionally large number of cities over 100,000 population in this zone. Another is the presence of unique geological forms in the Clinton sandstones permitting subterranean storage of gas produced by this technique.

The Clinton sand in Ohio is unlike the gas-producing sands found elsewhere in the Appalachian area, in that whereas in the States of New York, Pennsylvania, West Virginia, Kentucky, and Tennessee where natural gas is found, the producing sands are practically continuous. In Ohio the Clinton sand is what the geologists call lenticular in nature. The productive areas are extremely spotty, varying in size from a few acres supporting a single well to large areas covering several townships. While the spotty area of production is a headache to the wildcatter and the geologist, it has one very definite advantage in that it makes possible the repressuring of the near-depleted wells and the storage of large quantities of gas underground.

Several such areas in two groups have been so used for several years by the Ohio Fuel Gas Co., and no doubt many other such areas are available among the many spots of Clinton and in Ohio. The pipe lines operated in conjunction with these storage areas cross the coal-producing areas of Ohio at many points, loc. cit. A unique advantage claimed is that there is practically no loss of gas.

The gas-distribution lines, already mentioned, may be seen on the map and one authority has likened Ohio to the gas granary of the Appalachian area. As far as discernible at this moment, future demands for fuel energy are going to capitalize the convenience factor of gas and liquid fuels. A price differential is gladly paid by the consumer in recognition of this convenience factor which comes from the form of the fuel.

Mr. T. H. Kerr has pointed out that using certain designs for the process contemplated, this plant could make an appreciable contribution to the gas supply of this whole area by reason of the already existing storage and distribution facilities and the already established demand. This has an immediate bearing on present recognized deficiencies in the general gas supply for this area. Already much of our economic technology is dependent upon the hydrocarbons derived from gas and petroleum. One might almost predict, therefore, that the establishment of this research in a highly industrialized area would many times justify the expenditure by virtue of the contributions made to fun-

damental industries running the whole gamut from synthetic rubber to vitamins.

5. Looking finally to the post-war picture, researches of the type contemplated will place this country on an equal footing with foreign competition.

Mr. PETERSON of Florida. Mr. Chairman, I yield 5 minutes to the gentleman from Texas [Mr. LANHAM].

Mr. LANHAM. Mr. Chairman, I am sure we all realize the gravity of the petroleum situation and it is a subject in which we must be vitally interested. We tried to be helpful in its solution in this body some time ago by passing a bill which would encourage private industry to produce more oil for our country. The testimony of experts has shown that there is a great deal more petroleum available in deeper pools but that exploration is not feasible without some increase in the price of crude oil.

We have been told that the supply now in sight will last us only about 14 years. When we stop to contemplate the importance of petroleum and its products, not only in time of war but in all the civilian operations of peace, it is a most urgent matter for our deliberation, consideration, and action.

I wish at this time, however, to call attention to another feature of this bill concerning which it is my purpose to offer two amendments.

Provision is made in the bill for the acquisition of patents and patent rights by the Government. One section provides that these patent rights of individuals may be acquired by purchase, by donation, by lease—or otherwise—I call attention to that last proviso. We certainly do not want any governmental condemnation of rights under a patent which the Government itself has granted. American initiative, American inventive genius, must necessarily depend upon the Government keeping this contract which in its essence has been a part of our system ever since the adoption of the American Constitution.

I have discussed this matter with the distinguished gentleman from West Virginia who sponsors this bill and with those in the Bureau of Mines who would control the operation of this measure if enacted. They are entirely agreeable to the adoption of these amendments. I think they will be helpful and clarifying in preventing friction and preventing any effort at governmental abrogation of patents or deprivation of patent rights to those entitled to them. I understand, furthermore, that the distinguished gentleman from West Virginia has received a letter from the Secretary of the Interior quite in accord with the purpose of the amendments I am offering. I am sure, therefore, that they will be in no way controversial, but I desire at this time to call attention to them in order that this bill when and if enacted may be administered in accordance with its primary purpose and function, that of seeking to implement our petroleum supply without the friction that would necessarily follow if we should have these unwarranted interruptions and interferences with rights under patents.

The CHAIRMAN. The time of the gentleman from Texas has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from Ohio [Mr. BREHM].

Mr. BREHM. Mr. Chairman, at the expense of being accused of provincialism, I would like to say that no measure has been before the Congress which if enacted into law will do more to aid my section of Ohio, both from an economic and social standpoint, than this resolution.

Mr. Chairman, I ask unanimous consent to extend my remarks in the RECORD, at which time I will go into the various phases of the economic and social features regarding this bill.

The CHAIRMAN. Is there objection to the request of the gentleman from Ohio [Mr. BREHM]?

There was no objection.

The remarks referred to will appear in the Appendix of the RECORD within the next 5 legislative days as agreed to by the Committee of the Whole.

Mr. PETERSON of Florida. Mr. Chairman, I yield 4 minutes to the gentleman from Utah [Mr. GRANGER].

(Mr. GRANGER asked and was given permission to revise and extend his remarks in the RECORD.)

Mr. GRANGER. Mr. Chairman, first of all, may I congratulate the subcommittee on Mines and Mining, appointed to investigate the possibility of utilizing our vast natural coal and oil shale resources, with a view to their further development, upon the efficient manner in which the investigations have been made. I hope, as a result of their efforts, the people of our country, yes, and the peoples of the world might be greatly benefited therefrom. Special commendation should be given to the chairman of this Committee [Mr. RANDOLPH], the gentleman from West Virginia, who has so energetically and fairly conducted the hearings and investigations, without the slightest degree of partisanship or sectional interest. Although he comes from the great coal-producing State of West Virginia, he has been entirely fair to all coal-producing sections of this country. Yet the fairness and impartiality that he has shown, has in nowise lessened his enthusiastic efforts in behalf of and in the interest of his own people of West Virginia.

Coal, strictly speaking, is our greatest natural resource. This being true, it seems strange indeed that so little public money has been spent in research to determine the best utilization of this great natural resource. In spite of the lack of interest that the Federal Government might have shown in a financial way, it has, through the Bureau of Mines and in cooperation with private enterprise, entered the field of research to the degree that many uses for coal have been discovered. If it could be proved, through research and demonstration, that the many uses are economically feasible, it would add to the wealth and well-being of our people.

The average man thinks of coal as fuel to burn to keep himself warm or as something to be used to generate steam

²Geological Survey of Ohio, fourth series bull. 34.

³"Report of the facilities in Ohio favorable to the location of proposed plant for the hydrogenation and liquefaction of coal."—T. H. Kerr, Ohio State Engineering Experiment Station, July 1943.

for the propelling of locomotives in the field of transportation, or perhaps for the development of power to generate electricity. These are all beneficial uses to be sure, but we have learned from our research that there are many other uses for this most valuable product, uses that are now limited either because of lack of knowledge or because of the economic factor curtailing its use. In addition to the foregoing uses of coal, there are other potential uses from its by-products, such as gasoline, crude oil, petroleum products, city gas, cokes, smokeless fuels, chemicals for synthetic rubbers, plastics, and fertilizers.

When we take into consideration that the extent of our coal as a neutral resource being some 3,200,000,000,000 tons, I doubt that anyone is in a position to say that we are utilizing this natural resource to the limit of its usefulness or that we have even discovered its most economical value.

As I understand it, the purpose of the legislation we are here discussing is to promote research and experimentation, not in any way to take the place of or interfere with private enterprise, but rather to furnish laboratory facilities to assist private enterprise in this instance, the same as it has done in many other fields of endeavor.

The hearings held by the committee disclosed that they were primarily concerned with the question of feasibility of producing oil, gasoline, and rubber from coal and oil shale. These commodities were especially emphasized because of their need in the prosecution of this global war, which in a large measure is being fought on rubber and with oil. Therefore, my remarks will emphasize the possible use of coal and oil shales in their production for fuel.

I do not care to enter into the argument as to whether there is now or will be in the very near future a shortage of crude oil hiding in the depths of the earth, inasmuch as we cannot see it or measure it. Statements that there are great quantities or small quantities of oil, while based on some geological knowledge, are more or less speculative. On the other hand, coal and oil shales, while subject to some calculation, are more visible and therefore permit of more accurate estimation.

The Department of the Interior, through the Bureau of Mines, estimates our assets in natural resources as follows:

	Valuation	Percent national income
Coal, all grades.....	\$9,980,000,000,000	0.9
Iron ore, all other minerals.....	1,645,000,000,000	.5
Petroleum, oil shale, natural gas.....	75,000,000,000	.6
Water power.....	5,000,000,000	1.4
Forests, farms, fisheries.....	65,000,000,000	
All industries and manufacturing.....	113,000,000,000	30.6
Public and private building.....	140,000,000,000	

These figures show the value of our coal resources is more than four times as much as all the other resources combined, yet the national income from coal for the year 1942 was less than 1 percent.

From actual tests that have been made, it seems to have been generally established that our bituminous coal contains gasoline, ranging all the way from 136 to 58.2 gallons of gas per ton of coal in the Sunnyside coal beds of Utah, to 27.2 gallons of gas per ton of coal at the Beulah coal beds in North Dakota. As these figures indicate, a ton of Sunnyside coal will average 18.2 percent potential gasoline.

As I have just said, you will note the 58.2 gallons of potential gasoline multiplied by the number of estimated tons of coal in this area would add up to a lot of gasoline. It is estimated that there are about 200,000,000,000 tons of coal underlying the 13,000 square miles in Utah, the veins varying in thickness up to 35 feet, enough coal I am told at the normal consumption to last the United States 250 years. The amount of oil existent in this Utah coal and the figure 58.2 gallons per ton that I have given you has been determined through experiment known as the hydrogenation process. As I understand it, when this process is completed, you have 58.2 gallons of gasoline and the coal, as coal, has vanished. Therefore, the question to be determined is whether that 58.2 gallons of gasoline is worth more as gasoline and other by-products, or as a ton of coal. Some people will definitely say it is worth more as coal, while others will say there are other processes that have been tried and others yet to be tried by which byproducts are worth more than the coal itself. As a matter of fact, there have been other experiments carried on by which we may have some valuable byproducts left. By the process of distillation, the same process as applied to shales, coal will yield as much or more oil as the shales and at the same time the semicoke will be a by-product which is superior to the raw coal itself for all purposes. The credit from this smokeless byproduct, gas and semicoke, will make oil from coal cheaper than from shales and sands.

As an example of what can be produced from these remarkable coals, it has been shown by the cooperative researchers of the State of Utah and the Federal Government that from a ton of average coal—from the Mesa Verde formation—there is obtainable 30 to as high as 44 gallons of crude oil, heavy fuel oil, and critical chemicals for war needs, also 2,000 to 3,000 cubic feet of gas of the same heating value as natural gas, and 1,200 to 1,400 pounds of semicoke, which these large-scale researches proved to be superior to raw coal for all domestic and industrial heating purposes, for metallurgical uses, and for production of hydrogen for the Fischer-Tropsch hydrogenation process.

Before I conclude, I want to call attention to the oil shales' part of the committee's investigation. Again, I have some startling figures in connection with oil sands and shales lying directly over the coals in Utah. In the Uintah Basin in eastern Utah, we have the largest oil-bearing sands and shale deposits in the entire country. There are mountains of it standing before your very eyes waiting for someone to give it the magic touch. It is estimated there are 2,500,-

000 acres that would yield 30 to 40 gallons of gasoline per ton. To a person who casually drives through these parts, he thinks of it as a desert of wide-open spaces surrounded by mountains, while in reality these valleys and mountains hold these treasures, the potential value of which cannot be equalled in any other similar area in the entire world. Therefore, it is easy to understand why I am so interested in this legislation, and I hope it will be passed. It is my understanding if this proposal becomes law, it will be the duty of the Bureau of Mines to determine the type of plants and where they will be located, and I am quite sure the people of my State will cooperate in every way with the Bureau of Mines in furnishing data proving these startling figures and will press their claims for a plant to be placed in Utah.

In conclusion, may I express the hope that this legislation will make it possible that all processes and patents may be used to explore and further utilize our coal and oil shales. As I previously said, we have no definite knowledge of the extent of our oil reserves and by the same token we do not know what our needs will be in 10, 20, or 50 years from now. The events of the world today should impress upon us the vital necessity, as a means of pure national security, that we prepare ourselves for any eventuality.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 10 minutes to the gentleman from Illinois [Mr. CALVIN D. JOHNSON].

Mr. CALVIN D. JOHNSON. Mr. Chairman, fear has been expressed that an experimental industry such as this might conflict with private enterprise. Frankly, I have no such apprehension. My reason for this opinion is because of the experience of the mining industry in my own State.

In checking into its history we find that our most productive year was 1923. The mines of Illinois during that year produced 80,000,000 tons of coal. From that time on, our production declined until the year 1941, when only 46,000,000 tons were produced. During the same period employment dropped from 100,000 to 45,000. The reason for this drop in production was the enactment by several cities of smoke ordinances which barred high volatile Illinois coal. When production declined an investigation was made by the Illinois General Assembly. Following this investigation an appropriation of \$180,000 was made to develop a smokeless fuel from Illinois coal. The investigation developed that only 30 percent of the coal used in the city of Chicago was mined in the State of Illinois. We found that 50 mines out of 60 had closed in the Belleville area because Illinois coal would not meet the requirements of the St. Louis smoke ordinance. Even now we are making frantic efforts to improve our product, but it appears that we are locking the barn after the horse is stolen.

We have lost our markets to higher grades of fuel from the East, and although the fuel beds of Illinois contain approximately 200,000,000,000 tons, it is useless unless it can be mined and sold.

I see a direct parallel between the oil industry and the coal industry. They both produce fuel. The mining industry did not realize the problem that faced it and, as a result, did not prepare. It faced the emergency virtually bankrupt and Illinois felt justified in assisting that industry to meet its problem.

I feel that it is the duty of government to conduct these experiments and develop an economical process of hydrogenation of coal for the production of gasoline and fuel oil. Known resources of crude petroleum will be exhausted within 14 years at the present rate of consumption. If hydrogenation processes are developed, there is a sufficient supply of coal in the Nation to meet the needs for both gasoline and fuel for 1,000 years. The Government should pay for these experiments as the entire Nation will benefit from this great natural resource.

Mr. COMPTON. Mr. Chairman, will the gentleman yield?

Mr. CALVIN D. JOHNSON. I yield to the gentleman from Connecticut.

Mr. COMPTON. The trouble in connection with this legislation is this: If this process is so commercially possible and would be commercially profitable, why is it that private industry has not gone ahead with this experimentation?

Mr. CALVIN D. JOHNSON. The reason private industry has not gone ahead with it is this. Gasoline can be produced from petroleum for approximately 5 cents per gallon. It will probably cost 15 cents per gallon to produce it from coal. As long as there is oil available, no industry is going into competition with another industry and spend 10 cents more per gallon for the production of a fuel than its competitor can produce it for. I predict that unless the Government conducts these experiments and develops this system, the oil industries of the Nation will work down to the last barrel or until they were forced to swing to the hydrogenation process. I believe that through Government assistance a system can be worked out where gasoline can be produced from coal at no greater expense than it can be produced from petroleum.

Mr. COMPTON. Why should the Federal Government in the meantime interfere in this situation? When the time comes that it is necessary for us to produce gasoline from coal, at that time private industry can take care of it well enough, without taking out of the Treasury this \$30,000,000 that is proposed to be appropriated here for that purpose.

Mr. CALVIN D. JOHNSON. I regret to disagree with the gentleman, but I feel that we approach that time in the same position we were in as to producing synthetic rubber. We spent \$700,000,000 in the construction of synthetic rubber plants and probably \$100,000,000 of that amount has been wasted and as yet we have no synthetic rubber available in any quantity. I am sure the gentleman and I would both like to have a new set of tires right now but we cannot get them because of lack of foresight. I am fearful that unless we go into a program of this kind that the time will come

when we shall both want gasoline and find ourselves unable to obtain it.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from New York [Mr. EDWIN ARTHUR HALL].

Mr. EDWIN ARTHUR HALL. Mr. Chairman, I will probably support this measure, but I am going to state very frankly that I share the views of some of the other gentlemen who have raised the point that private enterprise should have been allowed to take hold of this thing itself and start the ball rolling.

I wonder if many of you have read the rubber report No. 4 which was issued about a month and a half ago, in which the whole subject of the manufacture of synthetic rubber was discussed at length. I remember it was pointed out that only two new plants for the manufacture of synthetic rubber had been contemplated in the whole war program.

Frankly, I was very much disturbed over this matter and I looked into it further. I found that although there were various firms in private industry who were just crying to get into the synthetic rubber business, they had been prevented from doing so by rules, regulations, and technicalities. To me it seems a crime that the manufacture of synthetic rubber has been curtailed because of these reasons.

I am introducing today a resolution which deals with this whole subject. At the same time, while I want to say I expect to support this measure, I regret that a like sum is not being appropriated for the further manufacture of synthetic rubber and rubber products. My resolution reads as follows:

Whereas a recent Government report on rubber shows that only two new plants have been opened for manufacturing synthetic rubber; and

Whereas the present natural rubber stocks and remaining stock pile of tires are rapidly diminishing; and

Whereas it is estimated that 2,000,000 private automobiles were scrapped during 1943 and another 2,500,000 will be discarded in 1944 because of lack of tires; and

Whereas both the military and the civilian population need automobile transportation to win the war: Therefore be it

Resolved, That the Congress direct those in authority to find ways and means of establishing more facilities for the building of additional synthetic rubber for military and civilian use.

May I emphasize with the introduction of this resolution that 2,000,000 automobiles left the road in 1943, and the main reason, as mentioned in this rubber report, was that they did not have enough tires to go around. The report also prognosticated that 2,500,000 more automobiles would be off the road by the end of 1944. I know you agree with me that we are all interested in seeing civilian automobile ownership encouraged and continued, because I am sure we all feel that if we are to win the war the public must be kept on wheels, for efficiency's sake more than anything else.

So I feel that this resolution should be adopted. If we can spend thirty millions to experiment, we can afford to put a lot more money into something tangible. I am surprised that more action has not

been taken along these lines. I sincerely hope that in the future we shall be able to remedy this problem along with the one we are now considering. We must do more to meet the demands of military and civilian needs in synthetic rubber and we will have to act as soon as possible to save what private automobiles are left.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 3 minutes to the gentleman from Wyoming [Mr. BARRETT].

Mr. BARRETT. Mr. Chairman, I am very much in favor of this resolution. As has been mentioned by my colleague and friend from Ohio, the State of Wyoming is a great coal-producing State. We have 23 counties, and all but three of our counties are underlaid with coal. The State of Wyoming has 600,000,000,000 tons of coal within its confines.

I am not interested in this measure because we are a big coal-producing State, but some mention has been made of the question whether or not this is a war measure. If it were not for the fact that Germany about 20 years ago made an exhaustive study and carried on this sort of a policy in that country, we would not have today this war we are experiencing. They are carrying on this war with synthetic oil that they have been able to produce.

Mr. RANDOLPH. Mr. Chairman, will the gentleman yield?

Mr. BARRETT. I yield to the distinguished chairman of the subcommittee.

Mr. RANDOLPH. In the States of Wyoming, Utah, and Colorado are found 85 percent of all the oil-shale deposits of this country, as well as the great amounts of coal the gentleman has mentioned as being in the deposits in his own State. I think the gentleman is correct when he calls attention to the war-measure features of this bill. We know that the terrific drain on our petroleum supplies by the prosecution of the war has brought us nearer to the time when we scrape the bottom of the barrel. This is why we bring this legislation today to get ready now, not when it is too late to do this job.

Mr. BARRETT. I thank the gentleman very much.

May I say further that I do not believe this resolution will in any manner interfere with the right of private enterprise to carry on this work. It has been shown here that we can produce a gallon of gasoline from crude oil for 5 or 6 cents, but it takes about 17 cents to produce a gallon of gasoline from coal. No private enterprise can carry on this sort of a program, because there is no likelihood that it can produce gasoline from coal and get a return within 10 or 20 years. Therefore, this experiment has to be carried on by the United States, and we have to lead the way.

Mr. Chairman, I think this measure should pass.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from Colorado [Mr. ROCKWELL].

Mr. ROCKWELL. Mr. Chairman, we have heard much in recent months concerning the shortage of oil in the United States. The present consumption of oil

due to the constantly increasing requirements for our Army and Navy is reducing our reserves every day. It has been pretty well demonstrated that regardless of the amount of new development before and after the war, the United States will never again be able to supply its own needs from the underground wells within our own borders. The consensus seems to be that at the present rate of consumption our present oil resources, were it possible to procure them as needed, which cannot be done, would last from 7 to 14 years. What then?

Our economic life has been built around the mobile engine. It would make us very vulnerable were we to become dependent upon the resources of foreign countries for our supplies of gasoline and oil. Therefore, it seems time to discover and develop synthetic supplies of liquid fuel to take the place of the pools of oil that are steadily becoming less adequate for our constantly greater needs.

It has been known for many years that oil could be extracted from oil shale, oil sands, coal, and natural gas. As long as there was an ample supply of cheap underground oil, it was not profitable to develop them as resources of liquid fuel. Other countries, not so fortunate as we, have made great advances along this line. Germany, Britain, and Russia each have studied the refinement of gasoline and oil from shale and coal. Germany spent 13 years learning to produce synthetic fuels commercially. Much of the transportation in Germany during the war has been on fuel developed from these materials. If the United States shall continue to be self-supporting, she, too, must begin to find ways and means of producing fuel from these materials in commercial quantities.

There are two great sources of natural oil left in the world today. One is in the Caribbean Basin from Texas and Louisiana down through Venezuela. The other is the Middle East Basin including Iran, Iraq, Arabia, and Russia. It would be impossible for us to carry on another major war with the known resources of underground oil within the United States. Modern warfare is built on the mobile engine. Sixty-five percent of the tonnage of all supplies for our Army overseas has been petroleum products.

Our geologists and the Bureau of Mines tell us that there is sufficient oil shale in the United States to produce 92,000,000,000 barrels of oil, 75,000,000,000 from shales in Colorado, Utah, and Wyoming, and 17,000,000,000 from Kentucky and Indiana, a supply to last 65 years. The total quantity of petroleum produced in the United States from 1859 to 1941 was only 25,000,000,000 barrels. They further state there are 3,000,000,000,000 tons of coal in this country which would supply our needs for petroleum products for 1,000 years. While Germany, Great Britain, and Russia have through necessity carried on extensive experiments and have for years successfully extracted gasoline and oil from coal and oil shale, our Bureau of Mines has conducted two limited experiments in this country, one in Pennsylvania

with coal and one in Colorado with oil shale.

In the early 1920's the president of the Colorado School of Mines and two of his assistants came to Congress with a complete laboratory oil-shale retorting plant. It was set up in one of the committee rooms and demonstrated to the Senators and Representatives that oil and gas could be produced from oil shale. Shortly thereafter, Senator Phipps, then Senator from Colorado, sponsored a bill to appropriate \$50,000 for oil-shale research that resulted in the location of a small experiment plant at Rulison, Colo., the heart of these great oil shale reserves. The plant was brought from Scotland and was of the type they used there. This experiment showed that certain areas in Colorado yielded 185,000 barrels of oil per acre, or 25 to 40 gallons of oil to the ton, with an estimated average of 75,000 barrels an acre for all of Colorado's shale territory. In round figures, the products of oil shale are 10 to 20 percent oil, 25 to 30 percent water vapor and gas and 50 to 65 percent shale. As the result of this Rulison experiment, the Government set aside 45,000 acres of the adjoining land as a naval reserve. There are 900,000 acres of these oil shale lands in western Colorado alone.

Mr. William S. Farish, late president of Standard Oil Co. of New Jersey, 2 years ago testified before the Mines and Mining Committee that he believed synthetic gasoline would cost 18 cents a gallon. Other estimates run as low as 7 cents from modern methods. Gasoline from petroleum costs 6 cents. This makes synthetic gasoline much higher but those who have investigated believe these costs can be greatly cut by modern methods and machinery. The Bureau of Mines reports that as the result of their experiments 13 years ago in Colorado shales, a high yield of oil can be obtained. However, little is known regarding the application of any improvements in oil-shale retorting methods. Application of modern methods would give results much improved over those obtained 13 years ago. One of the professors at the Colorado School of Mines told me that he felt that research would show that oil shale could be produced economically in competition with liquid oil if the present price were raised 35 to 50 cents a barrel.

This is too big a task for the oil companies to undertake. Also, the knowledge gained should be for the benefit of all the American people and not for any one oil company.

We have before us a bill to appropriate \$30,000,000 to be used to carry on research and experiments toward the commercial production of gasoline and oil from coal, oil shale, oil sands, and natural gas. Its passage will be a guaranty that the United States will never be dependent upon outside sources for its gasoline and oil supply either at peace or in war.

Mr. BISHOP. Mr. Chairman, I yield 5 minutes to the gentleman from Ohio [Mr. LEWIS].

Mr. LEWIS. Mr. Chairman, I ask unanimous consent to extend my remarks in the RECORD.

The CHAIRMAN. Is there objection? There was no objection.

Mr. LEWIS. Mr. Chairman, I approve this measure, although I have the most profound respect for my colleague from Ohio, Dr. SMITH, whose sincerity is beyond question, and with whom I for the most part am agreed, especially in his attitude with respect to the expenditure of public funds. However, in my opinion the expenditure of the \$30,000,000 authorized by this bill is only an infinitesimal amount as compared with the benefits likely to flow from the expenditure. Our oil resources, as has been so fully detailed, are being rapidly exhausted. We are coming to the point where we will have to curtail the use of the internal combustion engine unless we find other resources of liquid fuel, and the hydrocarbon deposits represented in the coals of this country furnish the most available source of liquid fuel for the future. The various chemical combinations that may be made from the constituent parts of coal is perfectly marvelous. From coal we get dyes, flavoring extracts, rubber, and all sorts of materials that would ordinarily not be thought of as contained in the hydrocarbon of coal.

This proposal to construct Government-owned and operated research laboratories is in no sense in conflict with private industry. If it were I would be opposed to it. It is not. It is a supplement to private industry and is akin to Government-owned and operated experiment stations for farmers, and it will provide for the entire people of the country something not possible for private industry to furnish because private industry must depend for its continuance upon continuing profits, which manifestly cannot be derived from a research laboratory.

I realize that we are approaching the day when these natural resources of petroleum will be exhausted and we cannot afford to wait until that day is upon us. We must take advantage of the opportunity that time now affords and make the investigations and discover the cheap and efficient means of transforming the latent energy, stored up by sunshine pouring upon ancient forests, long since turned to coal, into fuel for the future. It can be done, as has been demonstrated over and over again, but we need this research laboratory to find the way it can be done most cheaply and effectively. I am sure that if we take time by the forelock and set up this sort of research laboratory now before the petroleum scarcity is upon us, we will find we shall have pushed back into the future by many, many years the day when America will be without liquid fuel for the internal-combustion engines upon which so much of the economy and civilization of this era is based.

The CHAIRMAN. The time of the gentleman from Ohio has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 5 minutes to the gentleman from Illinois [Mr. BISHOP], a very able member of the committee.

Mr. BISHOP. Mr. Chairman, as I understand this bill, having been active as a member of the whole committee and a

member of the subcommittee, there is no new bureau to be set up. This is to be carried out by the department which has been in operation in the past. It says in section 2, subsection (d) "to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation in effectuating the purposes of this act."

I am bringing that to your attention because many of the educational institutions throughout the country have been making this experiment on a minor scale. Exhibits shown by those who have made this experiment on a small scale showed the committee that the synthetic rubber tires were made at that time to run 10,000 miles. They also demonstrated other rubber products from coal. Coming from a mining district, which has the largest bituminous mines in the world, I can realize without being selfish on our own part, having the raw materials, we are anxious to mine that coal and also bring to the top the oil. In doing this we are supplying other parts of the country with much needed gas and byproducts from bituminous coal that may be found by means of these experiments. I am sure that the thousands and thousands of workers who may be benefited by this bill will more than pay the \$30,000,000 which is asked to make this experiment. You have been told here by other Members of the great shortage of oil and the great supply of coal, so you can see just how important it is that you make possible this experiment. As we go along in this program, and we hope this war ends tomorrow, we are only fortifying ourselves for that which may happen in years to come. Many of them have been accepted and many have been rejected. But after 3 years of this committee's actions, taking into consideration every factor that we knew how, it came out with the full endorsement of the entire committee. Men on this committee from territories of the United States that have no oil or coal, but who are very much interested that their people get the much needed gas and byproducts that may be found in either oil or coal, are in favor of it. So I urge you to support this bill that you, too, may enjoy the possibilities of the byproducts of this coal or oil.

The CHAIRMAN. The time of the gentleman has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield to the gentleman from Illinois [Mr. CALVIN D. JOHNSON] 1 minute to ask a question.

Mr. CALVIN D. JOHNSON. Mr. Chairman, we have developed in this Nation a great synthetic rubber industry and in so doing have made ourselves independent of rubber monopolies controlled by overseas countries. However, if we do not develop a new source of gasoline, we may find ourselves dependent upon overseas shipment when our present supply is exhausted. Will the chairman express an opinion on this subject?

Mr. RANDOLPH. As the gentleman from Illinois remembers, in my address to the committee I stated that if we did not go forward at this time with this type of

program we might very well find ourselves in a few years an importing Nation from the standpoint of bringing into this country huge petroleum supplies from other parts of the earth. No, I think the gentleman agrees with me, we have the resources to do a sensible job on the synthetic program now and should not wait until we are face to face with the fact of actual depletion of our supplies.

The CHAIRMAN. The time of the gentleman has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield 1 minute to the gentleman from Pennsylvania [Mr. TIBBOTT].

(Mr. TIBBOTT asked and received permission to revise and extend his remarks.)

Mr. TIBBOTT. Mr. Chairman, our wartime demands for aviation fuels are so tremendous that our petroleum resources are taxed to the utmost. Since there is such a drain on petroleum resources now, the question arises as to peacetime use of this very important commodity. It is a matter of such serious importance that now is the time for Congress to become vitally interested in giving aid to our civilian requirements for the future. Taking into consideration that we will be faced with importation of oil from foreign countries unless we have our own sources for gasoline and oil in time of peace, we cannot escape the provisions of the present bill providing for supplying our country with this most essential necessity. Coming from the bituminous coal region in my section of the State of Pennsylvania, I know we are sufficiently supplied with the materials for the producing of oil and gasoline. I am most heartily in favor of the pending legislation and sincerely trust it will pass without delay.

The CHAIRMAN. The time of the gentleman has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I yield such time as he may desire to the gentleman from Colorado [Mr. CHENOWETH].

(Mr. CHENOWETH asked and received permission to revise and extend his remarks.)

Mr. CHENOWETH. Mr. Chairman, I favor the passage of the pending bill. In southern Colorado we have large deposits of bituminous coal which has proven excellent for coking purposes. This coal is high in its content of byproducts.

In Pueblo, Colo., is located the Minnequa steel plant of the Colorado Fuel and Iron Corporation. For some years this company has been operating a byproducts plant. Coke is available in large quantities and is used in this plant. Mr. Chairman, the production of gasoline from coal has been going on at this plant for some time. No attempt has been made to produce gasoline in commercial quantities. However, in talking to officials and employees of the company at this plant I am informed that they use this gasoline in their own cars and it has proven as satisfactory as any other gasoline purchased at regular filling stations.

My purpose in mentioning this is to impress upon the House the fact that the production of synthetic liquid fuels from

coal, as proposed in this bill, is nothing new or novel. It is now being done with success. As I understand this bill, it provides that experimental plants shall be established to explore the possibilities of commercial production of gasoline from coal and other substances. In view of our dwindling oil supplies, it is highly important that we determine just what can be accomplished by this process.

The bill specifically provides that these experimental plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry. After this information has been made available it will then be up to private industry, and particularly those engaged in the production of coal, to decide whether this suggestion is feasible. All that the Government will do is to make the experiment and submit the facts. Coal operators in my district have already indicated their interest in this proposal. I am sure the Bureau of Mines can be depended upon to conduct this research and development work honestly and efficiently. Their efforts will be closely followed and the results awaited with great anticipation.

Mr. BRADLEY of Michigan. Mr. Chairman, that is all the requests I have for time on this side. I yield back the balance of our time.

Mr. PETERSON of Florida. Mr. Chairman, I yield 2 minutes to the gentleman from Pennsylvania [Mr. EBERHARTER].

Mr. EBERHARTER. Mr. Chairman, I am not a member of the Committee on Mines and Mining and I do not assume to speak with too much authority on the measure now before us. I am very happy, however, that this afternoon several Members of the Congress during the debate on this measure gave recognition to the wonderful work that has been done by the Bureau of Mines of the Department of the Interior, which is located in my home city of Pittsburgh, where the feasibility of the development and obtaining of gasoline from coal has been proven. I am also happy, Mr. Chairman, that this afternoon or early tomorrow, by passage of this act, the Congress will be doing something of a constructive nature for private enterprise. I am glad indeed that so many of my Republican colleagues give recognition to that fact. Of course, we all know, and it has been demonstrated in my home city, that gasoline produced from coal will operate automobiles and aeroplanes, but we do not know at this stage whether or not it is possible or practicable to produce gasoline from coal in such a manner that it will be worth while in the economy of this country. And so we have the necessity of the Government giving its aid and assistance in this manner to private industry. I hope, Mr. Chairman, that there will be no votes against the passage of this progressive piece of legislation.

The CHAIRMAN. The time of the gentleman has expired.

Mr. PETERSON of Florida. Mr. Chairman, I yield back all time that has not been used on this side.

The CHAIRMAN. The Clerk will read.
The Clerk read as follows:

Be it enacted, etc., That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available is authorized to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products.

SEC. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, donation, or otherwise, land, and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this act. Sections 321 and 322 of the act of June 30, 1932 (47 Stat. 412), as amended, shall not apply to any leases under this section; and such leases may be made for a term of years notwithstanding Revised Statutes, section 3679, as amended, or any other provision of law.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State Government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this act, and to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this act.

SEC. 4. All moneys received under this act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the 1st day of January of each year a report of all operations under this act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this act. The authority and duties of the Secretary of the Interior under this act shall be exercised through the Bureau of Mines of the Department of the Interior.

Mr. PETERSON of Florida. It is my intention to move shortly that the Committee rise, and it will be in order to offer amendments when we resume later.

The CHAIRMAN. The Clerk will report the first committee amendment.

The Clerk read as follows:

Committee amendment: On page 2, line 2, after the period, insert "The plants shall be

of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products."

Mr. PETERSON of Florida. Mr. Chairman, I move that the Committee do now rise.

The motion was agreed to.

Accordingly the Committee rose; and the Speaker having resumed the chair, Mr. DELANEY, Chairman of the Committee of the Whole House on the state of the Union, reported that that Committee, having had under consideration the bill H. R. 3209, had come to no resolution thereon.

PERMISSION TO ADDRESS THE HOUSE

Mr. PETERSON of Florida. Mr. Speaker, I ask unanimous consent that after the regular business on tomorrow, the gentleman from New York [Mr. DICKSTEIN] may address the House for 20 minutes, and that his request for permission to speak today may be waived.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

EXTENSION OF REMARKS

Mr. JENKINS. Mr. Speaker, I ask unanimous consent to revise and extend the remarks I made this afternoon and to include therewith an article written by Dr. MacQuigg, with reference to the subject under discussion this afternoon.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

Mr. TIBBOTT. Mr. Speaker, I ask unanimous consent that my colleague [Mr. FENTON] may extend his own remarks in the Record and include an article on converting coal into gasoline and oil.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

GENERAL LEAVE TO EXTEND REMARKS

Mr. PETERSON of Florida. Mr. Speaker, I ask unanimous consent that all Members may have 5 legislative days within which to extend their own remarks on the subject matter under discussion.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

LINCOLN AND THE MANPOWER DRAFT

The SPEAKER. Under previous order of the House, the gentleman from Michigan [Mr. WOODRUFF] is recognized for 20 minutes.

Mr. WOODRUFF of Michigan. Mr. Speaker, Abraham Lincoln spoke two fundamental truths, which might be spoken today, with an application to our affairs as close as their application to the affairs of that past day in which Lincoln spoke. He said:

As I would not be a slave, so I would not be a master. This expresses my idea of

democracy. Whatever differs from this, to the extent of the difference, is no democracy.

He uttered another profound truth when he said:

Familiarize yourself with the chains of bondage and you prepare your own limbs to wear them. Accustomed to trample on the rights of others, you have lost the genius of your own independence and become the fit subject of the first cunning tyrant who rises among you.

The American people have been familiarizing themselves with the chains of bondage in the form of bureaucratic regulations; rationing of foods; point stamps; literally a new system of currency; repeated trips to ration boards, and generally onerous regulations, prescribed by men never elected by the people, who never submit their policies to public discussion, who never permit the debate and compromise where their regulations are concerned, all of which characterize the proceedings in the legislative branch of the Government.

It is true, of course, that these regulations have, to a very great degree, been made necessary by the desperate struggle in which we are engaged. It was inevitable that, in event of war, a great deal of administrative law, which means bureaucratic regulations having the force of law, would be necessary to coordinate the operations of American industry, American agriculture, and American labor. Nobody objects to any necessary regulations; but it has become increasingly apparent that a great mass of these regulations represent the whims of bureaucrats grown arrogant, and seeking more firmly to entrench themselves in their positions of power, both for the duration of the war and for a long time after, rather than necessary regulations required to coordinate the operations of industry, agriculture, and labor.

Mr. BRADLEY of Michigan. Mr. Speaker, will the gentleman yield?

Mr. WOODRUFF of Michigan. I yield.

Mr. BRADLEY of Michigan. Is it not true that in recent years there has been a constant decrease in the number of laws made by Congress which regulate the lives of the people, and a tremendously alarming increase in the number of directives that daily affect our lives.

Mr. WOODRUFF of Michigan. Unquestionably.

Mr. BRADLEY of Michigan. So much so that last year there were about 200 acts of Congress that affected the lives of people and about 20,000 bureaucratic directives.

Mr. WOODRUFF of Michigan. Unfortunately, what the gentleman from Michigan states is correct. Many of these regulatory measures are conflicting, contradictory, obviously unnecessary, and greatly confused. They are, therefore, losing all character of necessary administrative measures and are beginning to look suspiciously like the links with which the chains of bondage could be forged.

What a wise man the immortal Lincoln was, how well he knew the habits of mankind, when he said:

Familiarize yourself with the chains of bondage and you prepare your own limbs to wear them.

The most wholesome, the most healthy, the most encouraging sign in America today, that sign which tells us that the American people will never submit to wearing the chains of political bondage or bureaucratic government, is the fact that they are not only grumbling, they are rising in righteous wrath and aggressive indignation against these bureaucratic regulations which are unnecessary, contradictory, and confused. The people have become familiar with these bureaucratic regulations, but they have not become accustomed to them, and they most emphatically are not reconciled to them.

Abraham Lincoln, when the necessities of a desperate situation required him to take measures which were declared in his day unconstitutional, and which the legislative branch of the Government later validated by special acts, exercised the powers which he assumed only so long as it was necessary for him to do so, and then, voluntarily and with great eagerness, returned those powers to the people through their Congress. No American today believes for a moment that if the great Lincoln had not been assassinated he would have sought a third term or a fourth term in violation of the honored tradition established by George Washington, and observed by every President since then, except the present incumbent of the White House.

There has been a different attitude for the last 12 years in this country on the part of the Executives concerning the possession and exercise of power. We all know that the present occupant of the White House has constantly sought more and more power, under the claim of endless crises and emergencies, so-called. I know of not a single instance in which he has voluntarily returned any of these powers to the Congress.

I want to warn this House that the proposed Manpower Draft Act, concealed under a more euphonious name, is the most dangerous measure ever proposed to the Congress. Known by the name of its sponsors, the Austin-Wadsworth bill, it is a proposal sponsored by and backed up by the executive department to put every man, woman, and child in the service of the Government under a military dictatorship. The administration would have you believe, and the administration propagandists are striving to make you believe, that this measure has been necessitated and that it was conceived by reason of the necessities of the present war. As a matter of fact, the present bill was written into the industrial mobilization plan in 1936 by the present administration, and the specimen act was printed therein. The industrial mobilization plan was a plan by which the General Staffs of the Army and Navy would coordinate the operations of industry, agriculture, and labor. So then, this plan to put everybody under a military dictatorship, so people could be torn from their homes, so families could be separated, and the members sent anywhere the Commander in Chief should decide to send them, to do what-

ever kind of work they would be directed to do, regardless of their age, physical or financial condition, was conceived by this administration prior to 1936, and not after we entered the present World War.

Again, in another revision of the industrial mobilization plan in 1939, this administration wrote in a provision looking to the continuance of all of the war powers and regulations over the civilian population, for an indeterminate period after the war should end, and until the Commander in Chief—the President—should decide that a satisfactory readjustment to a peace-time basis had been achieved. Now, mark you, that plan was conceived prior to 1939 and was not the outgrowth of this war. The administration sought to conceal this change in the industrial mobilization plan and refused to let the press have copies of the 1939 revision. It was Michigan's own Senator, ARTHUR VANDENBERG, who secured a copy of it and had it published as a Senate document in order that the people might know what was being prepared for them, what chains of bondage, military regulations, bureaucratic orders, trials by court martial, were being prepared for them.

Now, my friends, no amount of argument, no amount of dissembling, no amount of political fog or propagandized mirages can obscure or distort the plain fact that prior to 1936 this administration was planning on enslaving the people under a manpower draft act, if a war should come along. No sort of mental gymnastics or literacy smoke-screen can obscure or distort the fact that this administration planned, prior to 1939, to hold onto its war powers, and to keep its clutch on the liberties of the people, to keep those chains of bondage, those fetters of bureaucratic control fastened securely upon the limbs of the American people for a long time after any war should end.

This Manpower Draft Act is not needed. This statement has recently been confirmed by no less a personage than Paul McNutt, chairman of the War Manpower Commission, than whom there is a no more faithful, no more subservient Presidential "me too" in Washington. He is quoted by the press as saying that the manpower draft bill is not necessary to meet manpower needs, but he would support the drive to force such a measure through the Congress.

The fact that the American Legion for 20 years has advocated a universal draft act does not remove the fact that we are dealing with an administration, which in every hour of its existence has sought to gain more and more control over the lives, the liberties, the property, and the activities of the American people. That administration has never hesitated to break a solemn promise. It has never hesitated to try to override the Constitution when the Constitution stood in the way of its rapacious appetite for power and still more power. It has not been content, this administration, with seeking to assist industry and agriculture and labor and society in general to achieve adaptation to new world conditions. Instead, this administration has sought by

violent hands literally to remake the whole economic structure of the United States.

So, then, my friends, just as Abraham Lincoln said at Gettysburg in 1863:

We are now engaged in a great . . . war, testing whether any nation conceived and dedicated in liberty and to the proposition that all men are created equal can long endure.

In that same wonderful speech he said:

We are testing whether or not this Nation, under God, shall have a new birth of freedom, and that Government of the people, by the people, for the people shall not perish from the earth.

I say to you that this iniquitous proposal contained in the Austin-Wadsworth manpower draft bill is a step directly away from a government of the people, by the people, and for the people. It is a step designed to lead to exactly a situation which Abraham Lincoln himself foresaw when he said:

At what point then is the danger to be expected? I answer, if it ever reached us, it must spring up among us. It cannot come from abroad. If destruction be our lot, we must ourselves be its author and finisher. As a nation of freemen we must live through all time or die by suicide.

If the time ever comes in America when a minority can frustrate the will of the majority, the result will be monarchy upon the one hand or tyranny on the other.

This dangerous measure which is proposed to the Congress would lead exactly in the direction of a danger which Mr. Lincoln clearly foresaw when he said:

It is to deny what the history of the world tells us is true, to suppose that men of ambition and talents will not continue to spring up amongst us. And when they do, they will as naturally seek the gratification of their ruling passion as others have done before them. The question then is, Can that gratification be found in supporting and maintaining an edifice that has been erected by others? Most certainly it cannot.

Many great and good men, sufficiently qualified for any task they should undertake, may ever be found whose ambition would aspire to nothing beyond a seat in Congress, a gubernatorial or a Presidential chair; but such belong not to the family of the lion, or the tribe of the eagle. What, think you, these places would satisfy an Alexander, a Caesar, or a Napoleon? Never! Towering genius disdains a beaten path. It seeks regions hitherto unexplored. It sees no distinction in adding story to story upon monuments of fame erected to the memory of others. It denies that it is glory enough to serve under any chief. It scorns to tread in the footsteps of any predecessor, however illustrious. It thirsts and burns for distinction; and if possible, it will have it, whether at the expense of emancipating slaves or enslaving free men.

Is it unreasonable, then, to expect that some man possessed of the loftiest genius, coupled with ambition sufficient to push it to its utmost stretch, will at some time spring up among us? And when such an one does, it will require the people to be united with each other, attached to the Government and laws, and generally intelligent, to successfully frustrate his designs.

• Our heroic men and women are fighting and bleeding and dying on the far-flung battle lines of this globe in order to assure that government of the people, by the people, and for the people shall endure in their own beloved country, and not perish from the earth.



business in competition with the private major oil company monopoly, I am worried on the other hand about the oil companies invading the Government in competition with the American people. And second, I now read in the press once again statements that "petroleum reserves will last only 14 years." I am not prepared to say that this may not be accurate, but I do wish to warn the House that I first read that our petroleum reserves would last only 14 years when I was a small boy of about 10 years and I have been reading the same thing continuously at 5- or 10-year intervals ever since.

What is needed is a determination of the facts in this matter by a truly independent governmental agency which will get its information from sources other than the controlled findings of the major oil companies themselves. Accordingly, I am introducing a resolution today calling for a complete investigation of this whole petroleum matter by a committee of the House consisting of three members of the Committee on Public Lands, three members of the Committee on Naval Affairs, three members of the Committee on Military Affairs, three members of the Committee on Interstate and Foreign Commerce, three members of the Committee on Agriculture, and three members of the Committee on Mines and Mining. I should have preferred to place this matter in the hands of one of the standing committees of the House but in view of the fact that several committees are directly interested and jurisdiction therefore uncertain, I felt the resolution in its present form was the best I could do. The important thing is for the job to be done and to be done at once, for the American people are entitled to accurate and complete information on this all-important subject.

EXTENSION OF REMARKS

Mr. WASIELEWSKI. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD, and include therein an article by Mark Sullivan, and further to extend my remarks in two instances and include in each an editorial.

The SPEAKER. Is there objection to the request of the gentleman from Wisconsin?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. MCKENZIE. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD, and include therein an editorial.

The SPEAKER. Is there objection to the request of the gentleman from Louisiana?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. WOLCOTT. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD, and include therein an article by Mr. Merlo Pusey, entitled "Short Cuts to Roll-back Subsidies," appearing in the Washington Post of February 15, 1944.

The SPEAKER. Is there objection to the request of the gentleman from Michigan?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. BROWN of Ohio. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD relative to a letter I have received from a soldier in the South Pacific.

The SPEAKER. Is there objection to the request of the gentleman from Ohio?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. BUSBEY. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD and include therein an address delivered by the gentleman from Massachusetts, Hon. JOSEPH W. MARTIN, Jr., minority leader of the House of Representatives, at the Lincoln Day Banquet held in Washington, D. C., on Thursday, February 10, 1944.

The SPEAKER. Is there objection to the request of the gentleman from Illinois?

There was no objection.

[The matter referred to appears in the Appendix.]

LINCOLN'S BIRTHDAY

Mr. GROSS. Mr. Speaker, I ask unanimous consent to address the House for 1 minute.

The SPEAKER. Is there objection to the request of the gentleman from Pennsylvania?

There was no objection.

Mr. GROSS. Mr. Speaker, I hold in my hand one of these calendars that are printed by the Government, I suppose, and are hanging all over America. I observe that every national holiday is set out in red on this calendar except Lincoln's birthday, which receives no recognition. This is the first time I have ever noticed this or that it has been called to my attention. Whoever is responsible should be censured severely. If it is an oversight, he should make the proper public apology.

I include in my remarks a letter from a patriotic constituent of mine who says:

YORK, PA., February 10, 1944.

HON. CHESTER H. GROSS,
Washington, D. C.

DEAR CHESTER: I suppose you have seen some of the calendars the United States Government is distributing to the different offices in the United States. It has a picture of the Capitol at Washington, but the thing that took my attention most was the fact that February 12, which, of course, is Lincoln's birthday, is printed in black type, whereas all the calendars that I have seen have this particular date printed in red type.

I am sure this was done deliberately by some New Dealer in Washington, and I, as an American citizen and a good Republican, highly resent this slur on one of our great Presidents.

There is one of these calendars hanging in the office of city draft board No. 2, and I suppose they are in all similar offices in the United States.

Kindly verify this condition and if you find it correct, think you should give them a "blast" on the floor of Congress.

I am writing this letter in a hurry and also in anger, and hope it reaches you before you leave Washington for the week end.

With kindest personal regards, I am,
Sincerely yours,

EDWIN F. HIVEY, Jr.

EXTENSION OF REMARKS

Mr. ABERNETHY. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD and include therein a resolution adopted by the State Legislature of Mississippi.

The SPEAKER. Is there objection to the request of the gentleman from Mississippi?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. WORLEY. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD and include therein a letter appearing in this morning's Washington Post.

The SPEAKER. Is there objection to the request of the gentleman from Texas?

There was no objection.

[The matter referred to appears in the Appendix.]

LINCOLN DAY SPEECHES

Mr. BULWINKLE. Mr. Speaker, I ask unanimous consent to address the House for 1 minute.

The SPEAKER. Is there objection to the request of the gentleman from North Carolina?

There was no objection.

Mr. BULWINKLE. Mr. Speaker, I have read all these Lincoln Day speeches and I observe that my friends on the Republican side are engaged at the present time in two battles. One is that they seem to be fighting Mr. Willkie, and the other is that they seem to be fighting Mr. Roosevelt. I can understand how they might fight Mr. Roosevelt, but after what I heard 4 years ago from Republican Members of this House on the floor and from newspaper reports of speeches in the way of praise of Mr. Willkie, I cannot see why they are treating him in such a manner now.

DESECRATION OF LINCOLN'S BIRTHDAY

Mr. RANKIN. Mr. Speaker, I ask unanimous consent to proceed for 1 minute and revise and extend my remarks.

The SPEAKER. Is there objection?

There was no objection.

Mr. RANKIN. Mr. Speaker, in reply to both gentlemen who have just spoken, let me call attention to the fact that the nearest thing to a desecration of Lincoln's Birthday that I know of was a party thrown by Marshall Field 3d, the playboy millionaire from Chicago, here in Washington on Sunday last.

I am told that he threw a party that would make Belshazzar's feast look like a Chinese soup kitchen. They had everything from cocktails to caviar. I understand that he spent more than \$7,500 on that wasteful revelry at a time when every American is being called on to save and buy bonds in order to fight this war.

He is the same Marshall Field who last September received a fortune of \$70,000,000 that has entirely escaped tax-

tion, and is now being used to finance PM, a Communist publication that is being used to malign the white people of the South, stir up race trouble, promote communism, and discredit the Congress of the United States.

I hope the Commissioner of Internal Revenue attended that party as an observer, for I am trying to get him to bring suit to collect the taxes on that vast fortune before Mr. Field squanders it all in riotous living or in financing subversive publications.

The SPEAKER. The time of the gentleman from Mississippi has expired.

CONSTRUCTION OF CERTAIN PIPE LINES IN THE DISTRICT OF COLUMBIA

Mr. RANDOLPH. Mr. Speaker, I ask unanimous consent to take from the Speaker's table the bill H. R. 3916, to permit the construction and use of certain pipe lines for pneumatic-tube transmission in the District of Columbia, with Senate amendments thereto, and concur in the Senate amendments.

The SPEAKER. The Clerk will report the Senate amendments.

The Clerk read as follows:

On page 2, line 1, strike out "north" and insert "south."

On page 2, line 4, strike out "and" where it occurs the first time and insert "or."

On page 2, line 20, strike out "and" and insert "or."

On page 3, line 1, strike out "and" and insert "or."

On page 3, after line 6, insert:
"Sec. 4. The right to alter, amend, or repeal this act is expressly reserved."

The SPEAKER. Is there objection to the request of the gentleman from West Virginia?

Mr. MARTIN of Massachusetts. Mr. Speaker, I reserve the right to object. Will the gentleman kindly tell us what the amendments are?

Mr. RANDOLPH. Mr. Speaker, this legislation has to do with the laying of certain pipe lines in the District of Columbia. The House passed this bill several weeks ago. The Senate took action on it yesterday, and the amendments added by the Senate are simply corrective.

Mr. MARTIN of Massachusetts. They do not change the text?

Mr. RANDOLPH. No. The body of the bill is as we passed it in the House.

The SPEAKER. Is there objection to the request of the gentleman from West Virginia?

There was no objection.

The SPEAKER. The question is on concurring in the Senate amendments.

The Senate amendments were agreed to.

A motion to reconsider was laid on the table.

EXTENSION OF REMARKS

Mr. COFFEE. Mr. Speaker, I ask unanimous consent to extend my remarks in the Record and include an address delivered by Mr. Martin F. Smith.

The SPEAKER. Is there objection?

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. CRAWFORD. Mr. Speaker, I ask unanimous consent to extend my re-

marks in the Record and include an address delivered by John L. Boyd, on the League of Nations.

The SPEAKER. Is there objection?

There was no objection.

[The matter referred to appears in the Appendix.]

SYNTHETIC LIQUID FUELS FROM COAL AND OTHER SUBSTANCES

Mr. PETERSON of Florida. Mr. Speaker, I move that the House resolve itself into the Committee of the Whole House on the state of the Union for the further consideration of the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

The motion was agreed to.

Accordingly the House resolved itself into the Committee of the Whole House on the state of the Union for the further consideration of the bill H. R. 3209, with Mr. DELANEY in the chair.

The Clerk reported the title of the bill.

The CHAIRMAN. When the Committee rose last evening the first committee amendment was pending. The question is on agreeing to the committee amendment.

The committee amendment was agreed to.

The CHAIRMAN. The Clerk will report the next committee amendment.

The Clerk read as follows:

On page 3, line 9, after the word "firm", insert "educational institutions."

The CHAIRMAN. The question is on agreeing to the committee amendment.

The committee amendment was agreed to.

The CHAIRMAN. The Clerk will report the next committee amendment.

The Clerk read as follows:

On page 4, after line 14, insert a new section as follows:

"Sec. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this act."

The CHAIRMAN. The question is on agreeing to the committee amendment.

The committee amendment was agreed to.

Mr. LANHAM. Mr. Chairman, I have two amendments to offer. They relate to the same matter, although appearing at different places in the bill. I discussed them yesterday. It seems that they are in no way controversial. I ask unanimous consent that the two amendments be considered together in view of the fact that they relate to exactly the same matter.

The CHAIRMAN. Is there objection?

There was no objection.

Mr. LANHAM. Mr. Chairman, I offer the following amendments, which I send to the desk and ask to have read.

The Clerk read as follows:

Amendment offered by Mr. LANHAM: On page 2 strike out all of subsection (b), lines 15 to 25, inclusive, and insert in lieu thereof the following:

"(b) to acquire by purchase, license, lease for a term of years or less, or donation, secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclu-

sive licenses, and other rights and licenses under patents granted by this or any other nation; and to acquire by purchase, lease for a term of years or less, donation, or otherwise, land, and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property."

Amendment offered by Mr. LANHAM: On page 4, line 4, after the word "act", change the period to a colon and add the following: "Provided, That such licenses are consistent with the terms of the agreements by which such patent rights are acquired."

The CHAIRMAN. The question is on agreeing to the amendments offered by the gentleman from Texas.

The amendments were agreed to.

Mr. SMITH of Ohio. Mr. Chairman, I move to strike out the last word, to ask the gentleman from Florida [Mr. PETERSON] in charge of this bill where he is going to get the money to finance this program. Is the gentleman going to get it from taxation or by the sale of bonds to private investors, or is he going to get it via the Government printing press? Will the gentleman please answer that question?

Mr. PETERSON of Florida. Oh, I did not know that the gentleman was asking a question for information. I thought his question was merely rhetorical.

Mr. SMITH of Ohio. I am not asking a rhetorical question, but a factual one. Where are you going to get the money to finance this program? Are you going to get it from taxation, or the sale of bonds to private investors, or through the Government printing press?

Mr. PETERSON of Florida. Answering the gentleman, I might say that this program will make many millions of dollars for the Federal Government, and create an asset of great importance. If the gentleman will read the bill—

Mr. SMITH of Ohio. Mr. Chairman, I do not yield any further.

Mr. PETERSON of Florida. The bill provides—

Mr. SMITH of Ohio. Mr. Chairman, I decline to yield. I submit to the gentleman that the only way this money can be raised is by the Government printing it. We are not selling enough bonds to private investors and by taxation to pay the cost of government.

I ask, Is that good financing? The gentleman in charge of this measure has frankly and forthrightly stated that this proposed program cannot be expected to achieve results before the expiration of 4 years. This measure therefore can by no stretch of the imagination be considered as a war measure. On the contrary, it is an anti-war-effort measure.

The very means by which it must be financed should make clear to us that it cannot be anything other. The process of Government financing through the banks—that is, creating new money by simply printing it—is undermining our whole financial structure. The longer the war lasts, the more will the evils of this procedure manifest themselves.

From the standpoint of the war effort I consider this a dangerous and inimical measure. Thirty million dollars of additional Government printing-press money

would have its effect in further undermining the financial structure of the country and hinder our war effort. But worst of all it would serve the purposes of other nonessential and nonwar proposals. If you can print thirty million new dollars for this project which has no prospect of being helpful to the war effort, why is it not reasonable to suppose that you can print additional millions or even billions of dollars for other similar paternalistic undertakings?

This Congress has no right to authorize or to appropriate one single penny that is not absolutely essential to the prosecution of the war and the maintenance of minimum essential Government functions.

I sincerely believe that a vote for this measure is a vote to undermine our war effort and to prolong the war and add to our losses. I beg of you to respond to the crying need of our soldiers and the Nation to save every dollar possible for the war effort by voting down this proposal.

Mr. RANDOLPH. Mr. Chairman, will the gentleman yield?

Mr. SMITH of Ohio. I yield.

Mr. RANDOLPH. Mr. Chairman, I know that the distinguished Member from Ohio, in speaking of communistic procedures in government and bureaucracy, as he did yesterday, would not want to imply that the members of his own party on the Committee on Mines and Mining—Mr. ROEBSON of Kentucky; Mr. BRADLEY of Michigan; Mr. LANDIS, of Indiana; Mr. BISHOP, of Illinois; Mr. ROCKWELL, of Colorado; Mr. JOHNSON of Illinois; Mr. ELMER, of Missouri; Mr. BREHM, of Ohio; and Mr. ELLSWORTH, of Oregon—would have approved this measure and reported it unanimously with the Democratic members of the Committee on Mines and Mining if they thought for a single moment there was any intention or effort to be communistic in proposing that the United States build demonstration plants to produce synthetic liquid fuels from coal and other substances to protect our domestic needs, even if it was proposed in the cloudy days of war and not in a recognized era of peace.

The CHAIRMAN. The time of the gentleman from Ohio has expired.

Mr. SMITH of Ohio. Mr. Chairman, I ask unanimous consent to proceed for 1 additional minute to answer the question of the gentleman from West Virginia.

The CHAIRMAN. Without objection, it is so ordered.

There was no objection.

Mr. SMITH of Ohio. In answer to your question, I should like to say that the Eighth Ohio Congressional District elected me to the office which I am now holding. When I was elected and took my oath of office I went on the assumption that it was my duty to examine all the measures that might come before Congress and judge them on their merits and give no heed or consideration to partisan politics whatsoever.

The CHAIRMAN. The time of the gentleman has expired.

Mr. ANTON J. JOHNSON. Mr. Chairman, I offer an amendment, which I send to the desk.

The Clerk read as follows:

Amendment offered by Mr. ANTON J. JOHNSON: On page 1, line 7, after the word "coal", insert the following: "And one or more demonstration plants to produce liquid fuel from agricultural and forestry products."

Mr. ANTON J. JOHNSON. Mr. Chairman, I have no personal interest in this thing, no interest affecting my district, that is, in the immediate future; and none expected. I am only interested in the general welfare of our Nation and agriculture. I am for the bill. We have heard so much about the potential exhaustion of our petroleum, and I think it is well founded. I know from experience. I have had a little oil interest myself back in my own State. Recently it has come to my attention that there is a proposed request for another \$300,000,000 to be spent to manufacture synthetic alcohol from petroleum. I have that on pretty reliable information. Therefore I introduced H. R. 4096 on January 31, of this year, which would prevent the use of any further Federal funds for the manufacture of synthetic alcohol from petroleum.

Mr. BRADLEY of Michigan. Mr. Chairman, will the gentleman yield?

Mr. ANTON J. JOHNSON. I yield.

Mr. BRADLEY of Michigan. I would like to state to the gentleman that I am very much in favor of his amendment. Our committee worked carefully on the question of the production of rubber and synthetic gasoline or fuel by the use of alcohol. We are very much in favor of the gentleman's amendment.

Mr. ANTON J. JOHNSON. I thank the gentleman for his contribution. I want to give you a little more background on this. Almost 2 years ago it was my great privilege to sit for a few months on the Senate side with the Gillette committee, which was investigating the further industrial uses of agriculture and forestry products in industry. One day I was quite impressed with Dr. Rosten, a Polish scientist, who had done much work in Poland in the manufacture of alcohol, which was used in the manufacture of rubber. We also had there another scientist who was in this country at the same time. Dr. Rosten read from the record of the report of the Petroleum Institute that had been held the year before in California that there was only a visible or potential supply of petroleum to last this country for 13 or 14 years. He told us many things that were new to us in this country. He had just recently come from Poland and he said we are wasting in the United States and Canada over 700,000 tons annually of fermentable sugar in waste sulfite liquor which is going down our streams and polluting our streams.

When I first came to Congress in January 1939, I had been interested up to that time in motor-vehicle alcohol fuel blends. I had been using it in my own cars. I became familiar with the advantages of it. I took up the study of

what foreign countries had done in that respect.

Mr. COFFEE. Mr. Chairman, will the gentleman yield?

Mr. ANTON J. JOHNSON. I yield.

Mr. COFFEE. I want to compliment the gentleman on what he said about making alcohol out of waste sulfite liquors, and Dr. Rosten's fine work, which has resulted in the granting, by the War Production Board, of first priorities for a plant for the manufacture of alcohol out of sulfite liquors in the United States. That is in my own State.

Mr. ANTON J. JOHNSON. I want to go into that a little more in detail. I thank the gentleman for his contribution. Alcohol is synonymous in our thinking today with blended motor fuels and also rubber. They are vitally needed and perhaps we are going to need them not only in our war effort, before this war is over with the Japanese, but for some years to come, we do not know whether we can get any foreign rubber. Other countries have been using alcohol motor fuel blends. I do not care whether it comes from grain or from waste sulfite liquor or sawdust, which they can make, and I know it. I am speaking now of the great Northwest, where you do not have a lot of petroleum, but where you can make alcohol motor fuel and where you get economy of operation when such products are produced where the raw materials are available. England has been using it for many years. They have been using an alcohol blend and the Standard Oil Co. has.

The CHAIRMAN. The time of the gentleman has expired.

Mr. BRADLEY of Michigan. Mr. Chairman, I ask unanimous consent that the gentleman from Illinois be permitted to proceed for 5 additional minutes. I would also like to ask him if he will yield at this time for some questions.

The CHAIRMAN. Without objection, it is so ordered.

There was no objection.

Mr. ANTON J. JOHNSON. I yield.

Mr. BRADLEY of Michigan. The gentleman knows that the gentleman from Colorado [Mr. ROCKWELL] has a very similar amendment that he would like to add to your amendment. He would include the words "oil shale" to your amendment.

Mr. ANTON J. JOHNSON. I will accept that.

Not only has England been using it, but the Standard Oil Co. in England has been producing it over at its plant and they advertised it as "at last, the perfect motor fuel"; a blended alcohol. Yet we cannot get it here.

Cuba, our good neighbor to the south of us, has been using it. This is not hearsay because I checked with the Cuban Embassy this morning. On October 13, 1942, the O. R. P. A., which is comparable with our O. P. A., passed a resolution on motor fuel blends; Alcohol 65 percent, gasoline and naphtha 30 percent, 5 percent other petroleum oils, and so forth. They are getting along wonderfully with it. Yet we are suffering from a lack of those things.

I want to say to the gentleman from West Virginia [Mr. RANDOLPH] who is so deeply interested in this, that he told us a great story about a plane landing here, powered with synthetic gasoline made from coal. There was quite a story in the paper and I was greatly interested in it. I was proud of the progress that had been made. I was glad we were not going to be dependent upon foreign oils but were going to be self-sufficient with our own raw materials.

Mr. MAY. Mr. Chairman, will the gentleman yield?

Mr. ANTON J. JOHNSON. I yield briefly.

Mr. MAY. Coal is mined in marketable quantities in 37 of the 48 States of the United States. We have been producing coal for perhaps 100 years. Up to this time we have shipped it all in bulk without determining how many by-products might be extracted by chemical methods. With the oil industry estimated by Mr. Ickes to be exhausted within 13 or 14 years, why is it not important that we take some step now?

Mr. ANTON J. JOHNSON. Well, we should. I thank the gentleman for his contribution.

Along that line, we get our styrene largely from coal in the manufacture of synthetic rubber. About 25 percent of the ultimate raw material that goes into synthetic rubber comes from coal products.

With reference to that plane coming here, not long ago there was an automobile driven up on the Capitol Grounds, equipped with synthetic-rubber tires made from waste sulfite liquors. They first extracted the fermentable sugars, then converted the sugars into alcohol, then into Buna S rubber, all done by private capital up in Canada, and these cars are running all over the country on demonstration.

Mr. BRADLEY of Michigan. Mr. Chairman, will the gentleman yield.

Mr. ANTON J. JOHNSON. I yield.

Mr. BRADLEY of Michigan. The gentleman is aware of the fact that Dr. William Hale, an eminent scientist, estimated that for \$100,000,000 we could set up 100 farm grain-alcohol plants and produce more synthetic rubber than has been produced by the \$700,000,000 spent on synthetic rubber.

Mr. ANTON J. JOHNSON. There is no question about it whatever. I regard Dr. Hale not only as one of my personal friends but a great scientist and a leader in motor-fuel alcohol blends. If we had followed his teachings on this a little more we would be a great deal better off today.

Mr. FORD. Mr. Chairman, will the gentleman yield?

Mr. ANTON J. JOHNSON. I am sorry. My time has about expired.

Now, reference has been made to \$720,000,000 that has been spent in setting up synthetic rubber plants. There were only 200,000 tons set aside to be made from grain alcohol, and that was because of the fight put up on the other side of the Capitol, as well as on this side, to make rubber from agricultural products. Otherwise we would not have had any from grain alcohol. I do not

care whether the alcohol comes from grain sawdust or waste liquors, but there is only one plant today making butadiene from alcohol operated on private capital and it is not in full operation yet. That is only a small plant of 15,000 tons that is privately owned. All the rest are Government owned and they might be wiped out after the war is over.

The CHAIRMAN. The time of the gentleman from Illinois [Mr. ANTON J. JOHNSON] has again expired.

(By unanimous consent, Mr. ANTON J. JOHNSON was granted permission to revise and extend his remarks.)

Mr. ROCKWELL. Mr. Chairman, may I ask if my amendment adding "oil shale" was accepted?

The CHAIRMAN. We will first dispose of the amendments offered by the gentleman from Illinois. The question is on the amendment offered by the gentleman from Illinois [Mr. ANTON J. JOHNSON].

The amendment was agreed to.

Mr. ROCKWELL. Was my amendment accepted?

The CHAIRMAN. The Clerk will report the amendment offered by the gentleman from Colorado [Mr. ROCKWELL].

The Clerk read as follows:

Amendment offered by Mr. ROCKWELL: On page 1, line 7, after the word "coal", insert a comma and the words "oil shale."

The CHAIRMAN. The question is on agreeing to the amendment.

The amendment was agreed to.

Mr. FERNANDEZ. Mr. Chairman, I offer an amendment.

The Clerk read as follows:

Amendment offered by Mr. FERNANDEZ: On page 3, line 2, after the words "any industrial organization", insert "or any educational institution."

Mr. FERNANDEZ. Mr. Chairman, New Mexico is vitally interested in this bill. It is an oil-producing State, but it has also large deposits of coal. Unfortunately, because of lack of demand for coal, the coal miners have up until this war been able to operate only 1, 2, or 3 days a week.

The New Mexico School of Mines, I understand, has been giving some thought to this problem, and it is at their suggestion that I offer this amendment. It merely adds educational institutions to the enumerated list of persons and agencies which the Secretary of the Interior may utilize, if he deems it desirable, in carrying out the purposes of the bill.

I appreciate, of course, that the Committee on Mines and Mining approved and the committee has accepted an amendment permitting cooperation with such institutions. This additional amendment is broader, however, in that it would permit the Secretary to engage the services of the institution or its facilities, if he finds such an arrangement desirable and mutually advantageous.

Mr. RANDOLPH. Mr. Chairman, the committee accepts the amendment. We have "educational institution" used in another subsection of the bill. This amendment is perfectly in order, and if agreeable to the gentleman we will accept it at this time.

Mr. FERNANDEZ. I appreciate there has been an amendment made in the second paragraph, but I was not sure whether it covered the field I wanted to cover.

Mr. RANDOLPH. The committee certainly wants the measure to cover educational institutions as well.

The CHAIRMAN. The question is on the amendment offered by the gentleman from New Mexico [Mr. FERNANDEZ].

The amendment was agreed to.

Mr. CRAWFORD. Mr. Chairman, I offer an amendment.

The Clerk read as follows:

Amendment offered by Mr. CRAWFORD: On page 3, line 23, after the word "channels", strike out down to and including all the language in line 4 on page 4.

Mr. CRAWFORD. Mr. Chairman, here is an amendment to which I assume there will be a great deal of opposition, but I see no reason why we should go out today and tax the taxpayers or sell bonds to raise \$30,000,000 to do a job that private industry stands ready to do, and at the same time give the Secretary of the Interior, in his discretion, authority to dispose of lands, real and personal property, at any time he desires to do so.

Going through the report on this bill which is signed by Abe Fortas, Acting Secretary of the Interior, I find some very interesting language. Only a few weeks ago this House had before it a proposition which had to do with the oil industry. A showing was made, and the bill was passed on the proposition that new oil fields were not being discovered and development work was slowing down because of certain irregularities incident to the price ceilings on oil. This House acted on the showing there made. Now, Mr. Fortas comes along and in this report makes a dissimilar presentation to that used on oil which shows exactly how that kind of fellow operates in applying the same argument for different purposes. A proposition of this kind gives another reason why I opposed the bill yesterday afternoon. If you give a man enough rope he finally hangs himself if his mind runs along certain channels. Then he makes this fallacious argument:

Under present conditions we cannot rely upon industry to make the initial, unremunerative expenditure necessary to solve the technical and economic problems of synthetic fuel production.

I deny that statement and challenge Mr. Fortas to show that the people of this country are unwilling to provide risk capital to do this kind of job or any other kind of job that is necessary to be done in this country. Historically, we have done the necessary until the Government began to compete and drive out private enterprise.

I was amazed by the argument of my friend the gentleman from Illinois [Mr. ANTON J. JOHNSON] awhile ago when he demonstrated that certain types of equipment had appeared on these Capitol Grounds which had been financed and the bugs taken out of their performance as a result of the enterprise of private citizens. Why in the world do we at this time come in here and propose another \$30,000,000 gouge of the people of this country to

carry out an undertaking when we know full well that the people of this country have over \$100,000,000,000 standing ready to put into the private-enterprise system of this country if these Government bureaus and if the Congress would just for a few minutes let private industry alone and stop promoting these Government projects. I do not propose to support this bill now. I can understand why Members from coal districts—and, incidentally, I have a coal district myself—will come in here and support this kind of operation. Why do you want more than one pilot plant? If you have got to spend Government funds for this purpose, why not build one pilot plant, let the bugs be taken out of the process in that plant, and the process then turned over to private industry? Why go out here with a "pork barrel" proposition and put these plants all over the United States during wartime? You cannot answer that question satisfactorily to the people of the United States.

Mr. MAY. Mr. Chairman, will the gentleman yield?

Mr. CRAWFORD. I yield to the gentleman from Kentucky.

Mr. MAY. I should like to say that I agree somewhat with the gentleman from Michigan.

Mr. CRAWFORD. Why, of course, the gentleman agrees with a lot of it.

Mr. MAY. Not necessarily with what the gentleman has said but with his motion to strike out those lines. The purpose of the gentleman undoubtedly is to prohibit the Secretary from disposing of real estate at his will.

Mr. CRAWFORD. Yes.

Mr. MAY. I think the better way to reach that would be to amend that provision in the bill by inserting after the word "shall" in line 24 the words "subject to the approval of the Congress." Then he could sell land only if the Congress approved of it.

Mr. CRAWFORD. That certainly would be satisfactory to me. In other words, let the Congress of the United States control their own affairs instead of delegating the powers to these bureau heads and the departmental heads.

Mr. BRADLEY of Michigan. Mr. Chairman, will the gentleman yield?

Mr. CRAWFORD. I yield.

Mr. BRADLEY of Michigan. The gentleman just asked why more than one plant may be necessary. This bill is not confined strictly to the study of coal and coal derivatives.

Mr. CRAWFORD. I understand that, but this bill has a certain objective. If you will bring your scientific data and raw materials, and so forth, to a concentrated point you will get better results out of it.

The CHAIRMAN. The time of the gentleman from Michigan has expired.

Mr. RANDOLPH. Mr. Chairman, I rise in opposition to the pro forma amendment.

Mr. Chairman, the suggestion of the gentleman from Kentucky [Mr. MAY] is certainly in order and your Committee on Mines and Mining would be agreeable to an amendment of that type. We do know that a program of this kind must have certain lodgment of authority

within a Federal department of the Government. I do not think of this development of a synthetic fuel industry of the Nation as being solely in the hands of Secretary Ickes, John Smith, or any other man. I think of it, as I know the Members of this House think of it, as being under the direction of those experts of the United States Bureau of Mines who throughout the Democratic and Republican administrations have continued vital research programs. They have fostered developments which have been of great value and assistance to this country.

I believe, and I do not want to be misunderstood, that we too easily and too lightly bounce the ball of bureaucracy against the sounding board of prejudice and public opinion. I say that from my heart. I do not agree with the insidious phases of bureaucracy any more than my colleague from Ohio [Mr. SMITH], but it is factual that in Government departments there are those conscientious, skilled, and able men who have been of great assistance to the development of America. I cannot allow to go unchallenged certain criticisms which have been spoken, when we take into consideration what has been accomplished in this country in research.

Let us consider one example very briefly, the National Advisory Council for Aeronautics. Think of its record for a moment. Its work was created by Congress 29 years ago to deal with research and development problems of flight. It placed America definitely ahead of any other nation in the world from the standpoint of technical development of the airplane. In 1933 there was an aeronautical congress held in this country. The experts from the other countries were unanimous in saying that because of the research we had done in aeronautics we were 10 years in front of any other country. That was the testimony given by the representatives of other nations. What happened? We found later, to our dismay, that Germany had not gone along in the regular and slow routine of small research. Hitler had multiplied facilities for air research. Perhaps five times as much advancement had been made in 5 or 6 years under his prodding as we had in the United States. We realize however that the fine developments carried on at Langley Field, Va., were not enough, and this Congress in its wisdom went out to Sunnyvale, Calif., and established another great laboratory, and a third one at Cleveland, Ohio. It should not be difficult to convince anyone that the money this Government has put into this aeronautical research, some \$70,000,000 being invested, has given to this Nation a continuing return on the money spent and has proved of economic value. We know that its work served America as a safety measure for air transport and general flying in time of peace and that it gives to us a superior performance in time of war. Our existence as a country can well depend on the latter consideration.

Mr. Chairman, the dollars we spend on research and carefully conceived development of the programs which are for the well being of our people and the

advancement of America will pay dividends far in excess of the funds which are spent on the resources which are consumed. My colleagues, let us act with wisdom worthy of our leadership. Let us be far-visioned. Let us proceed in America, not far away from home, in the fact-finding development of a synthetic-fuels program.

The CHAIRMAN. The time of the gentleman from West Virginia has expired.

Mr. KELLEY. Mr. Chairman, I move to strike out the last word.

Mr. Chairman, I hope that this legislation is enacted. It will eventually assure the Nation of an adequate petroleum reserve for any emergency. The lesson taught us by the failure to provide a reserve of rubber should be sufficient to drive us immediately to a farsighted, sound business policy of assuring adequate reserves of all basic material.

The known petroleum reserves of the Nation are about 20,000,000,000 barrels. The annual consumption in 1943 was about one and a half billion barrels. If no further reserves are discovered, the entire 20,000,000,000 barrels would be consumed in 13 years. The program outlined by H. R. 3209 might well take 15 to 20 years before the work is completed to assure us the proper liquid fuels at satisfactory production costs. The program is a good insurance policy against a dearth of liquid fuel. We hope additional reserves sufficient for our needs will be discovered, but that still should not stop us from providing against a failure of these reserve discoveries at any time in the future.

A significant statement was made by Mr. Ralph K. Davies, Deputy Petroleum Administrator for War, in the course of an address at the annual meeting of the American Petroleum Institute in Chicago, November 1943. I quote:

Our experience over the past 5 years and the outlook for the future, as far as we can see it, suggests that whatever the reserves yet to be discovered, they will be found more slowly, with greater difficulty, and at greater expense than reserves have been found in the past. Current studies show that it is four or five times as difficult and costly to find a barrel of new reserves today as it was in the pre-1938 period.

All evidence gathered from authorities shows that with present discovery rate, the present production rate, and the prospects of consumption continuing because of the war to be heavy, leave us with reason to believe that we shall be feeling the pinch within 8 years, and that we shall have reached the end of our supply of petroleum in 13 years. We cannot afford to be indifferent to a sound, businesslike policy such as is being offered today.

There need be no fear that Government will enter into competition with private business. This is neither the purpose nor intent of this program. The Government function is to develop and perfect the best-known processes for acquiring liquid fuel from coal and shale. Private industry can take it then. My experience leads me to believe that the present oil companies would be willing to take up

whatever processes are developed by the Government.

The importance of the program is more apparent when we consider that petroleum obtained in the United States is furnishing the best lubricating oil in the world, and also the highest octane gasoline. Both are essential for the high efficiency of military airplanes. These factors have helped bring about the superiority of air power which we have achieved over Europe and the Pacific. Therefore, why not conserve this petroleum for such use—military and commercial? Why not produce suitable lubricants and gasoline by hydrogenation of coal to serve satisfactorily for many less exacting uses? Why put high-grade gasoline and lubricants to low-grade use? It has been said that gasoline obtained from hydrogenation of coal can be improved to 87-percent octane, suitable for most uses, but not so good for military planes.

Our duty seems to me to be clear. We must conserve the valuable and indispensable petroleum and provide a supplemental quantity of lower-grade fuel for all uses other than flying. For my part, I cannot disregard my duty toward posterity. I will support the bill.

Mr. VOORHIS of California. Mr. Chairman, I rise in opposition to the pro forma amendment.

Mr. Chairman, I will be quite brief. I come from an oil-producing State but I am very much in favor of the passage of this legislation. I am glad that an amendment has been added to include oil shale and agricultural products. Personally I do not believe that work of this character to determine the practicality of the production of gasoline and related products from other sources than petroleum can possibly be carried on any other way than with governmental support under existing circumstances and with the oil monopoly as powerful as it is.

I am not going to elaborate upon that statement right now because I hope to do so in an effective way within the next few days. Suffice it to say that in my opinion it is our duty to try to develop sources of these critical fuel materials from every possible angle in the United States, for certain it is that the degree to which we become dependent upon foreign sources will be that much weakness to our country. Perhaps we are going to have to do it, I do not know, but in any case we ought to do the very dead level best we can to provide these resources here at home and we should not be balked in that effort by any private interest whatever. For that reason I welcome this bill and I agree with the gentleman from West Virginia [Mr. RANDOLPH] that sometime in the future this money will be regarded as having been well spent and Congress will be applauded for its foresight in making this practical research possible.

Mr. MAY. Mr. Chairman, I offer a perfecting amendment to the text of the bill.

The Clerk read as follows:

Amendment offered by Mr. MAY: On page 3, line 24, after the word "shall," insert "subject to approval by Congress."

Mr. CRAWFORD. Mr. Chairman, will the gentleman yield?

Mr. MAY. I yield to the gentleman.

Mr. CRAWFORD. It appears to me that if the gentleman introduces those words we should strike out the three words "in his discretion"; then it would read that the Secretary of the Interior shall also have authority to dispose of any lands, and so forth.

Mr. MAY. Mr. Chairman, I think that is a proper suggestion.

The CHAIRMAN. Does the gentleman from Kentucky desire to modify his amendment?

Mr. MAY. Yes. I ask unanimous consent that my amendment may be modified according to the suggestion.

The CHAIRMAN. Without objection, the amendment will be modified, and the Clerk will report the modified amendment.

There was no objection.

The Clerk read as follows:

Amendment offered by Mr. MAY: On page 3, line 24, after the word "Interior," strike out the words "in his discretion" and insert "subject to approval by the Congress."

The amendment was agreed to.

Mr. CRAWFORD. Mr. Chairman, I ask unanimous consent to withdraw my amendment. My only object was to leave this in the hands of the Congress.

The CHAIRMAN. Without objection, the amendment offered by the gentleman from Michigan, will be withdrawn.

There was no objection.

Mr. FORD. Mr. Chairman, I move to strike out the last word.

Mr. Chairman, I am going to support the pending bill, H. R. 3209, for a very specific reason. In the first place, I am of the opinion that we might much better develop this synthetic-gasoline process and have it ready in case of need than not to develop it and need it and not have it. We had that experience with synthetic rubber and are still suffering as a result of our failure to prepare for this emergency.

My distinguished friend from Michigan says that private enterprise will take this process up and develop it. That would be fine, but they did not develop synthetic rubber to the point where it met our need when we got in the hole and were short of natural rubber. I am not criticizing them for this; I am just calling attention to the fact that they did not do it and that we had to spend \$670,000,000 to develop a synthetic-rubber program.

Another point I would like to make is this: It is said that if grain alcohol had been utilized, we would have been able to develop the same quantity of the elements of synthetic rubber for \$100,000,000 that have cost us \$670,000,000. That might be true, I do not know, but I do know that the amount of essential grain that would have been used would have brought about a shortage of food products in the United States, although it might have relieved the rubber shortage. I am informed that private enterprise and private institutions that are interested in the development of gasoline from coal, from shale, and byproducts appeared before the committee, and that

they were in full accord with this bill. I want to emphasize once more, Mr. Chairman, that we better have this process developed and ready for use even though we do not need it at this time, than to have the day come when we do need it and not have it.

Mr. SMITH of Ohio. Mr. Chairman, I offer an amendment which I send to the Clerk's desk.

The Clerk read as follows:

Amendment offered by Mr. SMITH of Ohio: On page 4, line 16, after the word "of," strike out "\$30,000,000" and insert in lieu thereof "\$5,000,000."

Mr. BRADLEY of Michigan. Mr. Chairman, a point of order.

The CHAIRMAN. The gentleman will state it.

Mr. BRADLEY of Michigan. Mr. Chairman, I make the point of order that the committee amendment having been adopted, it is not subject to new amendment at this time.

The CHAIRMAN. The gentleman from Michigan [Mr. BRADLEY] is correct. It is not in order to amend an amendment that has been agreed to. The Chair therefore sustains the point of order.

Mr. SMITH of Ohio. Mr. Chairman, a parliamentary inquiry.

The CHAIRMAN. The gentleman will state it.

Mr. SMITH of Ohio. Then no amendments whatsoever are permitted with respect to the amount provided in this measure?

The CHAIRMAN. The gentleman is correct.

Mr. SMITH of Ohio. Mr. Chairman, I move to strike out the last word.

Mr. Chairman, I want to read part of a letter which in my opinion, beautifully portrays the spirit of the Congress of the United States. A gentleman appeared in my office a few days ago and asked me to support a subsidy for a certain purpose. I am not going to mention his name, or his connections, as I am not authorized to do so, but from his letterhead it would appear that he represents an important organization.

Here is what he says in this letter:

We too are thrifty, rugged individualists. There is, however, just one point to make. In a situation of heavy losses and large inefficiencies, the correction of which will greatly increase our tax-paying power, what other way can you suggest than Uncle Sam's doing this job for the sake of all his children?

Mr. CRAWFORD. Will the gentleman yield?

Mr. SMITH of Ohio. I yield to the gentleman from Michigan.

Mr. CRAWFORD. This is an intelligent citizen?

Mr. SMITH of Ohio. He is of the age of responsibility.

Mr. CRAWFORD. I do not know him, I never heard of him before, but I will venture the statement that he is absolutely confused. With reference to Mr. Eccles, Chairman of the Board of Governors of the Federal Reserve System, he went up to New York the other day and made an address before the Tax Institute symposium pointing out that too much money in the hands of the people will bring inflation to us, if it ever ar-

rives. And with this I agree. He does not say anything about roll-back subsidies preventing inflation. He just talks about too much money in the hands of the people. Then there is Mr. Bell, Under Secretary of the Treasury, who goes out and makes his long speech of a few days ago and points out that there is too much buying power in the hands of the people. Yet your friend writes you a letter and says, "Let us have the Government take care of all the people as though they were irresponsible little children."

What in the world is the matter with the thinking people of the United States today? If this country is to be saved, it will be saved by the literate people, not by the illiterate or the racketeer element.

Mr. SMITH of Ohio. I thank the gentleman, and want to add this further comment. Government paternalism is both of endogenous origin and growth. It does not come about through public demand, as is commonly alleged, but from those in Government service.

The spirit in Congress for Government controlled and owned industry—that is, totalitarianism—is very pronounced. It is doubtful if the people realize how strong this feeling is in Congress, and I wonder if Congress itself knows where it is leading our country.

Mr. RANDOLPH. Mr. Chairman, I rise in opposition to the pro forma amendment.

Mr. Chairman, I desire to read a letter I have just received from the Petroleum Administrator for War. It follows:

PETROLEUM ADMINISTRATION FOR WAR,
Washington, D. C., February 16 1944.
Hon. JENNINGS RANDOLPH,
House of Representatives.

MY DEAR MR. RANDOLPH: On your inquiry today as to the relationship of a synthetic liquid fuels program to this war, I reply that the relationship is direct.

The R. A. F. air fleet that bombed Berlin last night uses in part British-made synthetic fuel. The Luftwaffe that met it uses in part German-made synthetic fuel. Japan has synthetic fuel. It is a matter of chagrin to Americans that we do not already have synthetic gasolines, although, fortunately, the dwindling natural petroleum with which this country was blessed have, through heroic measures of American industry, kept our air forces in the sky, our fleet on the seven seas, and our Armies on all continents.

It is not given to me to know how long this war will last, but I believe we will have enough natural petroleum to finish it. I do not believe we will have enough for another war, and all who study the question think that we will come out of the war to peace with a shortage of domestic natural petroleum.

We need synthetic liquid fuels now, but we have not got them. It took other nations years to develop their synthetics and even the great fuel industries of this country, which have urged this Government to embark forthwith on the program set forth in your bill, do not feel such new industry can be established quickly. It is our purpose to avoid any interference with the unknown future of this war, but the Army and the Navy and all familiar with synthetic fuel possibilities believe that we must start our program now.

Sincerely yours,

HAROLD L. ICKES,
Petroleum Administrator for War.

The CHAIRMAN. Under the rule, the Committee rises.

Accordingly the Committee rose; and the Speaker having resumed the chair, Mr. DELANEY, Chairman of the Committee of the Whole House on the state of the Union, reported that that Committee, having had under consideration the bill (H. R. 3209) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, pursuant to House Resolution 434, reported the same back to the House with sundry amendments adopted by the Committee of the Whole.

The SPEAKER. Under the rule, the previous question is ordered.

Is a separate vote demanded on any amendment?

Mr. PETERSON of Florida. Mr. Speaker, I make the point of order that a quorum is not present.

The SPEAKER. Evidently a quorum is not present.

Mr. COOPER. Mr. Speaker, I move a call of the House.

A call of the House was ordered.

The Clerk called the roll, and the following Members failed to answer to their names:

[Roll No. 28]

Allen, Ill.	Hinshaw	Newsome
Baldwin, Md.	Hobbs	O'Brien, Ill.
Bell	Hoch	O'Konski
Buckley	Hoffman	O'Leary
Burch, Va.	Holmes, Mass.	O'Neal
Celler	Horan	Pace
Chapman	Izac	Patman
Cole, N. Y.	Jennings	Patton
Cullen	Johnson	Pfeifer
Curley	Luther A.	Poage
Dawson	Judd	Pracht,
Dewey	Kennedy	C. Frederick
Dirksen	Keogh	Price
Disney	Kilday	Reece, Tenn.
Domeneaux	Kirwan	Reed, Ill.
Douglas	Kleberg	Robison, Ky.
Drewry	LaFollette	Rowan
Ellison, Md.	Lambertson	Russell
Elmer	Landis	Shafer
Elston, Ohio	Lea	Smith, Va.
Fay	Lemke	Smith, W. Va.
Fenton	Lesinski	Summers, Tex.
Fish	Luce	Taylor
Fulmer	Lynch	Thomas, Tex.
Gamble	McMillan	Thomason
Gifford	Magnuson	Treadway
Gordon	Mahon	West
Gorski	Mansfield,	Whelchel, Ga.
Hare	Mont.	White
Hébert	Mansfield, Tex.	Wilson
Heffernan	Monkiewicz	Winter
Hess	Morrison, La.	Worley

The SPEAKER. On this roll call 330 Members have answered to their names, a quorum.

By unanimous consent, further proceedings, under the call, were dispensed with.

The SPEAKER. Is a separate vote demanded on any amendment? If not, the Chair will put them in gross.

The amendments were agreed to.

The SPEAKER. The question is on the engrossment and third reading of the bill.

The bill was ordered to be engrossed and read a third time, and was read the third time.

The SPEAKER. The question is on the passage of the bill.

The question was taken; and on a division (demanded by Mr. SMITH of Ohio) there were—yeas 140, nays 113.

Mr. SMITH of Ohio. Mr. Speaker, I ask for the yeas and nays.

The yeas and nays were refused.

So the bill was passed. A motion to reconsider was laid on the table.

Mr. ANTON J. JOHNSON. Mr. Speaker, I offer an amendment to the title.

The Clerk read as follows:

Amend the title so as to read: After the word "coal", insert a comma and the words "agricultural and forestry products and oil shale."

The SPEAKER. Without objection, the title will be amended accordingly.

There was no objection.

Mr. PETERSON of Florida. Mr. Speaker, I ask unanimous consent to take from the Speaker's table a similar Senate bill, S. 1243, strike out all after the enacting clause and insert the provisions of the House bill (H. R. 3209) just passed.

The Clerk read the title of the bill.

The SPEAKER. Is there objection to the request of the gentleman from Florida [Mr. PETERSON]?

There was no objection.

The Clerk read the Senate bill, as follows:

Be it enacted, etc., That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than 5 years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. There is hereby authorized to be appropriated not to exceed \$30,000,000 for the purposes of this act. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products.

Sec. 2. In order to carry out the purpose of this act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work and with pilot plants and semiworks plants make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, lease for a term of years or less, or donation, land and any interest in land, including easements and leasehold interests; options on real or personal property; plants and their facilities; secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: *Provided, however,* That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization he deems suitable, to do

all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, or corporation, in effectuating the purposes of this act.

Sec. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, in his discretion, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this act. No patent or patent rights acquired by the Secretary of the Interior under this act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process to which such patent or patent rights relate, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

Sec. 4. All moneys received under this act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the 1st day of January of each year a report of all operations under this act.

Sec. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this act. The authority and duties of the Secretary of the Interior under this act shall be exercised through the Bureau of Mines of the Department of the Interior.

Mr. PETERSON of Florida. Mr. Speaker, I move to strike out all after the enacting clause and insert the provisions of the bill just passed, H. R. 3209.

The SPEAKER. Without objection, the motion is agreed to.

There was no objection.

The Senate bill was ordered to be read a third time, was read the third time, and passed.

Mr. PETERSON of Florida. Mr. Speaker, I move that the proceedings by which the House bill, H. R. 3209, was passed be vacated and that bill laid on the table.

The SPEAKER. Without objection, the proceedings whereby the bill, H. R. 3209, was passed will be vacated and that bill laid on the table.

There was no objection.

The SPEAKER. The title to the Senate bill will be amended accordingly.

WAR DEPARTMENT CIVIL FUNCTIONS APPROPRIATION BILL

Mr. SNYDER. Mr. Speaker, I move that the House resolve itself into the Committee of the Whole House on the state of the Union for the consideration of the bill (H. R. 4183) making appropriations for the fiscal year ended June 30, 1945, for civil functions administered by the War Department, and for other purposes.

Pending that motion, I suggest to my distinguished colleague from New Jersey

[Mr. POWERS] that general debate shall continue for 30 minutes.

Mr. POWERS. Mr. Speaker, I have no requests for time on this side. Does the gentleman from Pennsylvania think that 30 minutes will be sufficient to make his statement and for other Members to speak?

Mr. SNYDER. I have no requests for time.

Mr. POWERS. Might I suggest that we provide for 1 hour and if we do not use it, of course, we can yield it back. Let me further suggest that the time be equally divided between the gentleman from Pennsylvania and myself.

Mr. SNYDER. That is agreeable.

Mr. POWERS. I think that will be satisfactory to everybody.

Mr. SNYDER. Mr. Speaker, pending the motion I ask unanimous consent that general debate continue for 1 hour, the time to be equally divided between the gentleman from New Jersey [Mr. POWERS] and myself.

The SPEAKER. Is there objection to the request of the gentleman from Pennsylvania [Mr. SNYDER]?

There was no objection.

The SPEAKER. The question is on the motion of the gentleman from Pennsylvania [Mr. SNYDER].

The motion was agreed to.

Accordingly the House resolved itself into the Committee of the Whole House on the state of the Union for the consideration of the bill H. R. 4183, the War Department civil functions appropriation bill, with Mr. HART in the chair.

The Clerk read the title of the bill.

By unanimous consent the first reading of the bill was dispensed with.

The CHAIRMAN. The gentleman from Pennsylvania [Mr. SNYDER] is recognized.

Mr. SNYDER. Mr. Chairman, I yield myself 12 minutes.

Mr. Chairman, the bill we are about to consider provides for the so-called civil functions administered by the War Department. It embraces five activities—namely, cemetery expenses, Alaska communication system, civil works under the Corps of Engineers, local Soldiers' Home, Panama Canal.

For all, it makes available \$86,911,440, in addition to which there will be drafts upon currently available funds which will remain unobligated on next July 1, to the amount of \$24,566,539.

We are taking away, through repeal provisions, all unobligated balances in excess of that amount. The total amount we are repealing is \$34,957,572.

The bill contemplates by far the smallest expenditure program of any we have provided for since appropriations for war civil activities were divorced from the military appropriations act back in 1938. They reached a peak of roundly \$344,000,000. This bill, including the use of previously appropriated funds, calls for roundly \$111,000,000.

This tremendous reduction is responsive to these considerations:

First. The added expense occasioned by the war is borne by military appropriations as regards cemeteries and the Alaska communication system;

Second. River and harbor and flood-control activities are practically confined to maintenance, to avoid conflict with the war program; and

Third. The Panama project of protective works is drawing to a close and the new locks project virtually will be at a standstill.

There are six river and harbor improvement projects, itemized on page 4 of the report, upon which it is planned to expend a total of \$3,630,000, and there are but three construction projects under the flood-control head, listed at the top of page 5 of the report, upon which it is planned to expend \$1,017,000.

All of the flood-control money; that is, general flood-control money, except \$100, is to come from presently available funds withheld from expenditure upon projects for which appropriations heretofore have been made. The balance from such source is estimated to be \$16,115,000.

The bill exhausts all but \$4,000,000 of that amount, and that \$4,000,000 we are proposing the repeal of, because we found that the department, with Budget approval, had been employing funds appropriated for specific projects upon projects for which we had not been asked to appropriate.

We cannot quarrel with deferring work, but we feel that we should have a voice in the application of funds thus released. To insure that, we are taking away the unallocated balance.

We pursued that course, also as to rivers and harbors. The balance under that head will be \$1,482,750. We are taking away \$700,000, with the idea that the remainder should be available for contingencies of one kind or another.

The Budget contemplates the use of \$2,000,000 of the amount to be employed upon the general flood-control program for advance planning of projects not heretofore commenced. We have raised that two million to four million, cutting down by two million the amount that would be available for repeal.

My committee had the foresight to initiate advance planning in the 1943 fiscal year bill. The Congress has made funds available in the past for such use—approximately \$15,000,000 all told, both as to river and harbor and flood-control projects, and we are getting dividends in the way of a backlog of projects which may be immediately undertaken when the labor situation permits and the demand for critical materials somewhat subsides.

You will find in the hearings, on page 4, a list of river and harbor projects that have been made ready for commencement in consequence of our action heretofore, looking to cushioning the post-war adjustment. The cost to complete such projects is said to be \$163,000,000 plus.

Then, if you will turn to page 36 of the hearings, you will see a list of flood-control projects that have been or are being made ready for commencement when funds become available for so doing. The \$2,000,000 that the Budget submission contemplates will be employed on advance planning would be expended on that list. The \$2,000,000 which we have

I was privileged to appear before the committee. We had a very amicable session in relation to the joint resolution. I therefore ask unanimous consent to withdraw my motion.

The VICE PRESIDENT. Without objection, the motion will be withdrawn.

INVESTIGATION OF MARKET CONDITIONS AFFECTING HOG PRICES

Mr. LANGER submitted the following resolution (S. Res. 260), which was referred to the Committee on Agriculture and Forestry:

Resolved, That the Committee on Agriculture and Forestry, or any duly authorized subcommittee thereof, is authorized and directed to make a full and complete investigation with respect to market conditions affecting hog prices with a view to ascertaining whether packers are depressing such prices by refusing to buy hogs to which support prices are applicable, basing such refusal upon a lack of processing and storage facilities, and buying instead hogs which are above or below the weight range with respect to which support prices are payable. The committee shall report to the Senate at the earliest practicable date the results of its investigation, together with such recommendations as it may deem desirable.

For the purpose of this study and investigation, the committee, or any duly authorized subcommittee thereof, is authorized to hold such hearings; to sit and act at such times and places during the sessions, recesses, and adjourned periods of the Seventy-eighth Congress; to employ such clerical and other assistants; to require, by subpoena or otherwise, the attendance of such witnesses and the production of such correspondence, books, papers, and documents; to administer such oaths; to take such testimony; and to make such expenditures as it deems advisable. The cost of stenographic services to report such hearings shall not be in excess of 25 cents per hundred words. The expenses of the committee under this resolution, which shall not exceed \$, shall be paid from the contingent fund of the Senate upon vouchers approved by the chairman of the committee.

ADDITIONAL COPIES OF PART 2 OF REPORT NO. 539, RELATING TO THE CANCELLATION OF WAR CONTRACTS, ETC.

Mr. GEORGE submitted the following resolution (S. Res. 261), which was referred to the Committee on Printing:

Resolved, That 15,000 additional copies of Senate Report No. 539, part 2, current session, submitted by the Special Committee on Post-War Economic Policy and Planning, pursuant to Senate Resolution 102, relative to the "cancellation of war contracts, disposition and sale of surplus property, and industrial demobilization and reconversion," be printed for the use of said committee.

SPECIAL COMMITTEE TO INVESTIGATE CAMPAIGN EXPENDITURES, 1944

Mr. GREEN submitted the following resolution (S. Res. 263), which was referred to the Committee on Privileges and Elections:

Resolved, That a special committee of five Senators, to be appointed by the President of the Senate, from States in which no Senator is to be elected at the general election in 1944, is hereby authorized and directed to make a full and complete investigation with respect to—

(1) the extent and nature of the expenditures made by all candidates for the office of President, Vice President, and United States Senator in 1944 in connection with their campaigns for nomination and election to such office;

(2) the amounts subscribed and contributed, and the value of services rendered and facilities made available (including personal services, and the use of billboards and other advertising space, radio time, office space, moving-picture films, and automobiles, and other transportation facilities), by any individual, group of individuals, partnership, association, or corporation to or on behalf of each such candidate in connection with any such campaign, or for the purpose of influencing the votes cast or to be cast at any primary or general election, or at any convention, held in 1944, at which a candidate for President, Vice President, or United States Senator is to be nominated or elected;

(3) the expenditure of funds appropriated by the Congress with a view to determining whether any such funds have been or are being expended by any department, independent agency, or instrumentality of the United States, by any State or political subdivision thereof, or by any instrumentality of any State or political subdivision thereof, in such a manner as to influence the votes cast or to be cast for any such candidate at any such primary or general election or convention;

(4) the use of any other means or influence (including the promise or use of patronage) for the purpose of aiding or influencing the nomination or election of any such candidates; and

(5) such other matters relating to the election of President, Vice President, and United States Senators in 1944, and the campaigns of candidates in connection therewith, as the committee deems to be of public interest, and which in its opinion will aid the Senate in enacting remedial legislation or in deciding any contests that may be instituted involving the right to a seat in the Senate.

SEC. 2. The committee is authorized to act upon its own motion and upon such information as in its judgment may be reasonable or reliable. Upon complaint being made to the committee, under oath, by any person, candidate, or political committee, setting forth allegations as to facts which, under this resolution, it would be the duty of said committee to investigate, the committee shall investigate such charges as fully as though it were acting upon its own motion, unless, after a hearing upon such complaint, the committee shall find that the allegations in such complaint are immaterial or untrue. All hearings before the committee, and before any duly authorized subcommittee thereof, shall be public, and all orders and decisions of the committee, and of any such subcommittee, shall be public.

SEC. 3. For the purposes of this resolution, the committee, or any duly authorized subcommittee thereof, is authorized to hold such public hearings, to sit and act at such times and places during the sessions, recesses, and adjourned periods of the Seventy-eighth Congress, to employ such attorneys, experts, clerical, and other assistants, to require by subpoena or otherwise the attendance of such witnesses and the production of such correspondence, books, papers, and documents, to administer such oaths, to take such testimony, and to make such expenditures, as it deems advisable. The cost of stenographic services to report such hearings shall not be in excess of 25 cents per hundred words. The expenses of the committee, which shall not exceed \$30,000, shall be paid from the contingent fund of the Senate upon vouchers approved by the chairman of the committee or the chairman of any duly authorized subcommittee thereof.

SEC. 4. The committee by majority vote may authorize any member of the committee, or any member of a duly authorized subcommittee, to conduct on behalf of the committee any part of the investigation herein provided for, and for such purpose any member

so authorized may hold public hearings, issue subpoenas, and provide for the service thereof, require by subpoena or otherwise the attendance of witnesses and the production of books, papers, and documents, administer oaths, and take testimony.

SEC. 5. The committee, or any duly authorized subcommittee thereof, may authorize any one or more persons to conduct on behalf of the committee any part of the investigation herein provided for, and for such purpose any person so authorized may hold such public hearings, issue such subpoenas, and provide for the service thereof, require by subpoena or otherwise the attendance of such witnesses and the production of such books, papers, and documents, administer such oaths, and take such testimony, as the committee, or any such duly authorized subcommittee, may from time to time authorize.

SEC. 6. The committee shall report to the Senate on the first day of the next regular session of the Congress the results of its investigation, together with its recommendations, if any, for necessary legislation.

WASHINGTON'S FAREWELL ADDRESS—REMARKS BY SENATOR THOMAS OF UTAH RELATIVE TO THE ANNUAL CUSTOM OF READING THE ADDRESS

Mr. GILLETTE. Mr. President, I have received a letter from the Public Library of Des Moines, Iowa, which refers to the scholarly address by Senator THOMAS of Utah in connection with the annual reading of Washington's Farewell Address in the United States Senate. In the letter it is stated:

The Senator's commentary and analysis of Washington's famous document contains so much that is timely and of value that I wish it could be preserved in more permanent form.

Would it be in order for a book to be printed as a special Senate document containing both the Farewell Address and the address of the Senator?

I ask unanimous consent that the commentary and analysis by the Senator from Utah [Mr. THOMAS], as they appear in the Record in connection with his reading of the Farewell Address, be printed as a Senate document.

The VICE PRESIDENT. Without objection, it is so ordered.

PRODUCTION OF LIQUID FUEL FROM COAL

The VICE PRESIDENT laid before the Senate the amendments of the House of Representatives to the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

Mr. HATCH. I move that the Senate disagree to the House amendments, request a conference with the House on the disagreeing votes of the two Houses thereon, and that the Chair appoint the conferees on the part of the Senate.

The VICE PRESIDENT. The question is on the motion of the Senator from New Mexico.

Mr. LANGER. May I ask the distinguished temporary majority leader just what the difference is?

Mr. HATCH. The House made amendments, one of them relating to agricultural products to which I understand there is some objection. The

Senator from Wyoming [Mr. O'MAHONEY], the chairman of the committee, is ill and not able to be present. This morning I talked to him on the telephone and his thought was that the bill should go to conference, where the differences could be ironed out quickly.

Mr. LANGER. Does the Senator know what the differences are?

Mr. HATCH. I do not.

Mr. GILLETTE. Mr. President, may I ask the Senator is this the bill proposing to appropriate \$30,000,000 for demonstration plants to experiment in the production of liquid fuels from coal and other substances?

Mr. HATCH. This is the bill which the Senator has in mind. My motion is that the Senate disagree to the House amendments, request a conference with the House thereon, and that the Chair appoint the conferees on the part of the Senate.

The motion was agreed to; and the Vice President appointed Mr. O'MAHONEY, Mr. MURDOCK, and Mr. GURNEY conferees on the part of the Senate.

UNITED NATIONS RELIEF AND REHABILITATION ADMINISTRATION

The VICE PRESIDENT laid before the Senate the action of the House of Representatives disagreeing to the amendments of the Senate to the joint resolution (H. J. Res. 192) to enable the United States to participate in the work of the United Nations relief and rehabilitation organization, requesting a conference with the Senate thereon, and appointing conferees.

Mr. HATCH. Mr. President, I move that the Senate insist on its amendments, agree to the conference asked by the House and that the Chair appoint the conferees on the part of the Senate.

The motion was agreed to; and the Vice President appointed Mr. CONNALLY, Mr. GEORGE, and Mr. CAPPER conferees on the part of the Senate.

SECOND REPORT OF SELECTIVE SERVICE SYSTEM

Mr. REYNOLDS. Mr. President, the Second Report of Selective Service under section 6 of Public Law 197, Seventy-eighth Congress, has been submitted to the Senate and House Committees on Military Affairs by Col. Francis V. Keesling, Jr., on behalf of Maj. Gen. Lewis B. Hershey.

It contains information concerning the present and contemplated size of the armed forces, classifications, deferments, inductions of nonfathers and fathers, rejections of IV-F's, use of limited-service personnel, discharges, reemployment of veterans, and other matters which I believe are of interest to my colleagues.

The Senate Committee on Military Affairs will question General Hershey or Colonel Keesling at an early date concerning the various items in this report and also concerning the recent order of the President tightening up on occupational deferments and the recommendations of the President's five-man medical board that the standards for induction remain the same and that no increased volume of limited-service personnel be inducted.

The First Selective Service Report, filed under Public Law 197, appears at pages 157-169 of the CONGRESSIONAL RECORD for January 14, 1944.

So that the information contained in this report may be available to the Members of Congress, I ask unanimous consent that the report may be printed in the RECORD.

There being no objection, the report was ordered to be printed in the RECORD, as follows:

SECOND REPORT OF THE SELECTIVE SERVICE SYSTEM TO THE COMMITTEES ON MILITARY AFFAIRS OF THE SENATE AND HOUSE, UNDER PUBLIC LAW 197, SEVENTY-EIGHTH CONGRESS

SIZE OF ARMED FORCES—HOW SELECTIVE SERVICE PLANS TO FILL CALLS

The net strength which the Army and Navy plan to attain on or before July 1, 1944, is 11,300,000. Their net strength as of February 1, 1944, was approximately 10,600,000—a difference of 700,000—which number, together with an additional 500,000 which Selective Service estimates as the attrition from the armed forces from all causes during 5 months ending July 1, 1944, gives a total of 1,200,000 which Selective Service must furnish, or which must be enlisted. The 1,200,000 will require average calls and enlistments of 240,000 per month.

In meeting that requirement, Selective Service estimates that it will induct 420,000 out of the 1,500,000 in class I-A. It is estimated that of the 2,600,000 registrants in class III-A, approximately 860,000 will, upon reclassification, be placed in class I-A, of whom approximately 250,000 will ultimately be inducted. It is estimated that between 65,000 and 70,000 men will either enlist at age 17 or be inducted through Selective Service upon reaching 18 each month, giving a total of approximately 325,000 during the 5 months ending July 1, 1944. (See exhibit A for break-down of classes and method of determining the number which will be obtained from them and from the 17-year-olds.) That gives approximately 1,000,000 men that we may expect to get prior to July 1, 1944, leaving a balance of 200,000. These must be obtained from registrants occupationally deferred or physically rejected. Most of these should come from nonfathers of the younger-age brackets.

There were approximately 3,204,000 registrants in classes II-A and II-B, deferred in occupations other than agriculture, and approximately 1,680,000 in classes II-C and III-C, deferred in agriculture, a total of approximately 4,900,000 deferred by reason of their occupations. Class IV-F, those rejected from military service for failure to meet armed forces' standards, contained approximately 3,485,000.

No appreciable numbers will be obtained from class IV-F under existing standards and the application thereof which is within the exclusive jurisdiction of the War Department and the Navy Department. Therefore, the men must be obtained from the occupationally deferred classes.

There were 900,000 men (nonfathers) in the occupationally deferred classes between 18 and 26 years of age. Only about 500,000 of them would pass the physical examination. If we are to meet our requirements from that group of nonfathers, we would consequently have to take 2 out of every 5 of those who were physically qualified. (See exhibit B for break-down between agricultural and nonagricultural occupational deferments and between the 18 to 21 and the 22 to 26 age groups.)

We must meet the calls made on us by the armed forces. It is obvious that occupational deferments must be restricted and must be curtailed to the extent necessary for us to meet calls on time. War industries and

agriculture, therefore, together with the Government agencies which have been given responsibilities in the field of industrial and agricultural manpower procurement, must obtain replacements from the IV-F's, the overage, and women.

To carry out the mandate of Congress that we scrutinize occupational deferments and endeavor to get as many nonfathers as possible with which to fill each of our calls before using fathers, we have taken the following actions:

1. We arranged for appeal board where man is working to review an occupational deferment granted by a local board outside that appeal board area. This has required creation of numerous appeal board panels to industrial areas to carry the increased burden.¹

2. We restricted occupational deferments of registrants under 22 years of age.¹

3. We curtailed by special restrictive quotas the deferments of civilian students. This does not include students under War and Navy Department college programs.¹

4. Tightening up on farm deferments. (See exhibit C.)

5. Provided for the granting of more liberal deferments to pre-Pearl Harbor fathers over 21 years of age than to nonfathers. To do that, replacement schedules provide for the release of nonfathers before fathers engaged in essential war work. (See exhibit A for the number of nonfathers and the number of fathers in each selective-service class. See exhibit B for the number of fathers being placed into the various deferred classes and the number of nonfathers being removed therefrom.)

6. Based on best available information, we allocate calls to the States and have States, in turn, allocate them to their local boards, so that the available nonfathers will be used in filling each monthly call to the extent they are available before using fathers.¹

Under Public Law 197 the President appointed a five-man medical board charged with the responsibility of reviewing and recommending with respect to standards for admittance to the armed forces and the use of limited service personnel within the armed forces. Up to the time this report was drafted, no recommendations of that committee have been made public.

Public Law 197 also requires Selective Service to report on rejections and discharges. As of February 1, 1944, there were approximately 3,500,000 persons in class IV-F who were for the most part rejected under standards fixed and applied exclusively by the armed forces. The principal causes of rejection of the total number of class IV-F registrants are set forth in exhibit D. Exhibit E sets forth an estimate of the principal and also the secondary causes for rejection of registrants rejected during November 1943, and illustrates that many of those rejected for illiteracy, mental, or other reasons would have been rejected for another defect had illiteracy, mental, or one of the other standards been lowered or abolished.

Information concerning the 1,150,000 persons discharged from the armed forces because of disability is set forth in exhibit F. The standards for such discharges are, of course, fixed and applied exclusively by the armed forces.

The War and Navy Departments have contended they are utilizing the maximum number of non-general-service personnel they can use without impairing their present or future efficiency. The Army continues to take limited-service personnel from Selective Service at the rate of 5 percent of each monthly call. The Navy has not been taking any limited-service personnel from Selective Service. Both the Army and Navy are enlisting small numbers of WAVES and

¹ See first report, pp. 159-169 of CONGRESSIONAL RECORD, January 14, 1944.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

PERMISSION TO ADDRESS THE HOUSE

Mr. CALVIN D. JOHNSON. Mr. Speaker, I ask unanimous consent to be permitted, after the special orders for today, to address the House for 5 minutes.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

EXTENSION OF REMARKS

Mr. STEVENSON. Mr. Speaker, I ask unanimous consent to extend my remarks in the RECORD and to include therein a letter from the Conservation Director of the State of Wisconsin.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. MICHENER. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD and to include an article by Daniel M. Kidney.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. MICHENER. Mr. Speaker, I ask unanimous consent that the gentleman from Michigan [Mr. SHAFER] may extend his own remarks and include an article.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

Mr. MICHENER. Mr. Speaker, I ask unanimous consent that the gentleman from Michigan [Mr. HOFFMAN] may extend his own remarks and include an editorial.

The SPEAKER. Without objection, it is so ordered.

There was no objection.

[The matter referred to appears in the Appendix.]

CONSTRUCTION OF DEMONSTRATION PLANTS TO PRODUCE LIQUID FUEL FROM COAL AND OTHER SUBSTANCES

Mr. RANDOLPH. Mr. Speaker, I ask unanimous consent to take from the Speaker's desk the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, with House amendments, insist on the amendments of the House, and agree to the conference asked by the Senate.

The Clerk read the title of the bill.

The SPEAKER. Is there objection to the request of the gentleman from West Virginia? [After a pause.] The Chair

hears none and appoints the following conferees: Mr. SOMERS of New York, Mr. RANDOLPH, and Mr. ROBSON of Kentucky.

THE FIGHT FOR FREEDOM ON THE HOME FRONT

The SPEAKER pro tempore (Mr. WORLEY). Under previous order of the House, the gentleman from Michigan [Mr. WOODRUFF] is recognized for 15 minutes.

Mr. WOODRUFF of Michigan. Mr. Speaker, ever since the New Deal administration came to power 12 years ago, there has been a continuous and carefully planned drive by a clique in the White House to upset the checks and balances of our free constitutional government, and to concentrate absolute power in the person of the Chief Executive. Three bold and insolent attempts have been made to execute a coup to accomplish this nefarious purpose. The first attempt was when the President demanded of the Congress the right to appoint six additional judges to the Supreme Court, which would have enabled him to at once control that Court. Not many of you listening to me have forgotten how, in his attempt to influence the Congress, the President contemptuously referred to the splendid members of that Court as "those nine old men," inferring, of course, that these men were too old to properly discharge the responsibilities resting upon them. In his unholy attempt to destroy the independence and the power of our Court of last resort, Mr. Roosevelt stated that the work of the Court was so far behind that these proposed new justices were needed in order to bring the work up to date and to keep it there. Great must have been his embarrassment and confusion when it was promptly disclosed by the records of the Court that never in all its history had the work been more completely up to the minute than it was at that time, completely refuting every insinuation and every reason advanced by the President in support of his demand. This attempt by the Executive to destroy public confidence in the Supreme Court and the splendid justices then on the Supreme Court bench, and to pack that tribunal with men of his own selection who would construe the Constitution in the way Mr. Roosevelt wanted it construed, and thereby change our Government by judicial decree, was the most brazen attempt to destroy our tripartite system of government ever attempted by a President of the United States.

Outraged by such a brazen attempt to destroy the very fundamentals, and to tear asunder the very pillars upon which our free government was founded, even the President's own supporters in the Congress were compelled by sheer patriotism and devotion to principle to oppose him. He sought to destroy these patriotic members of his own party in the following election, when he staged his attempt to purge his party and the Congress of all who had dared to defy his mad ambitions.

As a companion measure to the court-packing plan, the White House clique, through the Chief Executive, endeavored to compel the Congress through the pres-

sure of patronage, punishment, and persuasion to empower the President to reorganize the Government in such a way as to leave the legislative branch impotent. Again, outraged by these bold and insolent attempts to transform our Government into a government by men, Democrats and Republicans alike, without regard to partisan lines, rose up and stopped that attempt.

It is true that through the mutations of time and the frailty of mortals, Mr. Roosevelt was enabled to pack the Supreme Court to the tune of 8 to 1, and he has appointed a majority of the lower Federal courts as well, with politicians of his choosing whom he felt sure would construe the Constitution as he wanted it construed. He was not greatly disappointed.

The third, and perhaps the boldest and most insolent attempt to transform the Government into a political oligarchy, while millions of our heroic men and women are absent on the fighting fronts, came in his series of vetoes of measures recently passed by the Congress. So long as he restrained himself to the act of the veto, he was well within his proper rights and functions as the Chief Executive. But in his veto of the tax bill, he not only broke another precedent—which Mr. Roosevelt delights to do—but he went beyond the exercise of his veto power, and in an abusive and insulting message to the Congress, sought to tell this House of Representatives what kind of a tax bill it should pass.

There is no function of the Congress more clearly defined in the Constitution than that of raising revenues, which action must originate in the House of Representatives, the branch of the Congress considered closest to the people. His message on the tax bill was exactly in line with his other insulting messages, notably his remarks concerning the bill to provide ballots for absentee service people, in which he accused the Congress of attempting to perpetrate a fraud upon the soldiers and the people and indulged in the palpable inference that the Congress was either crooked or stupid, or both. He proposed a ballot to be sent to our armed forces which, unless the legislatures of the States first legalized the same, could not legally be cast in a single State of the Union. He, of course, was aware of this fact.

Mr. Roosevelt, in his tax message, as in his remarks concerning the absentee-ballot bill, did not hesitate to depart from the facts and indulge in misstatements so grossly erroneous, so maliciously untrue, that in anyone lacking the dignity of the Presidency such action would have been characterized by a harsher term than any American wants to use in connection with the Chief Executive. So gross, so wanton, so unfair, and so dangerous was Mr. Roosevelt's action and his language in gratuitously insulting the Congress in his attempts to discredit the legislative branch in the confidence of the people that all but a mere handful of his own supporters in both the House and the Senate rose up and, as with one voice, repudiated his action in the most startling and remarkable rebuke a Chief Executive has received at the hands of

the people's Representatives in Congress in perhaps 100 years, certainly, at least, in the last 50 years.

There can no longer be any question in the mind of any clear-thinking person that the White House clique, intriguing for a dictatorship of life tenure for Franklin D. Roosevelt under the guise of a Presidential election and pseudo-democratic processes, is endeavoring to overturn constitutional government in their mad and frantic efforts to achieve their objective, regardless of its effect upon our war efforts, and of the death or injury which they may cause to be brought upon thousands and even hundreds of thousands of our men and women in the armed services locked in bitter struggle with the foreign foe. It is shameful, it is wicked, this deliberate attempt to destroy the confidence of the people in the Congress as a coordinate, independent branch of the Government because the Congress refuses to render itself subservient to the dictates of the man in the White House.

Patriots, earnest men and women on both sides of the aisle in both Houses of the Congress, realize fully what a statesman of another day, Elihu Root, put into words when he said in 1913:

If whatever great officer of state happens to be the most forceful, skillful, and ambitious, is permitted to overrun and to absorb to himself the powers of all other officers and to control their actions, there ensues that concentration of power which destroys the working of free institutions, enables the holder to continue himself in power, and leaves no opportunity to the people for a change except through revolution.

This latest and most brazen attempt by the White House cabal, through the Chief Executive, to break down our constitutional government, to destroy the checks and balances so carefully provided by the founding fathers, has put the American people on notice that if Franklin Delano Roosevelt and his White House clique can achieve a fourth term, free government will be so far gone in this Nation that it will be a question of whether or not the people can rescue it without a revolution. It will constitute a betrayal of the men and women on the fighting fronts. It will constitute a loss of the peace after we win the war, because it will mean the loss of free government in the United States of America.

The American people have begun to realize that the interference by British politicians in our internal political affairs is of a piece with these brazen and wicked attempts by the White House gang to break down constitutional government under cover of the Nation's peril and our struggle to win the awful conflict in which we are engaged. Never in the history of this Nation has it been more strikingly demonstrated that eternal vigilance is the price of liberty in America than has been the case for the last 12 years under this New Deal administration. The people are being compelled to recognize that it has never been a "new deal" administration, but that it has been an administration which for 12 years has plotted and schemed and worked to give the people the oldest deal in civilization—a deal of despotism. It has endeavored to throw American prog-

ress back 200 years and to set up again in this country the very sort of tyranny that the men and women of Bunker Hill and Brandywine, of Yorktown and Valley Forge suffered and died to drive from the continent of North America.

This attempt of betrayal of our fighting forces behind their backs in this effort to break down their constitutional government, is so utterly wicked and contemptible that it is no wonder the President's own spokesmen in the Congress had to revolt and denounce him and his works. It is a dreadful thing to have to happen in wartime and the blame for it lies directly on Mr. Roosevelt's desk in the White House.

The men and women who are plotting this wicked scheme, if they could accomplish it, if they could succeed in overthrowing our constitutional government of checks and balances, and in setting up a political autocracy in this Nation, while the people are fighting and struggling and sacrificing to repel foreign aggression, would be traitors beside whom Benedict Arnold would appear a patriot.

The American people may well thank benign providence that in this crucial hour, principle and patriotism blotted out partisanship and caused the men and women who love their country to rise in their places in the Congress of the United States and to strike down this third bold attempt to destroy free government in this country.

It is up to the American people, and I for one have no doubt the Members of the American Congress will meet their responsibility in overwhelming numbers, to defeat the next bold and brazen attempt to overthrow free government in this country by defeating the proposed universal draft act, under which every man between the ages of 18 and 65 and every woman between the ages of 18 and 50, will be regimented and controlled by some iron-fisted bureaucrat in Washington.

The SPEAKER pro tempore. The time of the gentleman has expired.

U. N. R. R. A. PROGRAM

The SPEAKER pro tempore. Under previous order of the House, the gentleman from Illinois [Mr. JOHNSON] is recognized for 5 minutes.

Mr. CALVIN D. JOHNSON. Mr. Speaker, on October 7, 1943, I stated on the floor of the House that the American people were being taken for the damnedest financial sled ride the world has ever known. I further stated that our Capitol had become the headquarters for the "Order of the Empty Satchel" where delegates assembled in answer to urging of starry-eyed globats who coursed the world, making lush and ridiculous promises of American goods and American dollars.

Today, Mr. Speaker, I reiterate those charges and submit this schedule as proof. This schedule contains the farm machinery program of U. N. R. R. A. It is the brain child of these crystal gazers whose heads are in the clouds and whose hands are in our pockets. Herein is contained a list of farm equipment, approximately 500,000 items, each representing an essential and necessary piece of machinery for which American farmers

have been pleading ever since Pearl Harbor. They propose to distribute machinery among approximately 15 nations of Europe, every one of which is at present occupied wholly or in part by Axis forces, and yet these utopian dreamers demand delivery of portions of this equipment by August 1, 1944.

Thirty thousand tractors are to be sent to parts of Europe, where in many instances the intended recipient has never seen one.

Thirty thousand plows are to be scattered all over Europe and paid for with American dollars.

Thirty thousand separators, 50,000 mowers, 17,000 reapers, 22,900 horse-drawn hay rakes, 40,000 harrows and harrow-sections and 12,000 binders, every item of which Members of Congress have endeavored to obtain for needy farmers.

Thirty thousand pieces of machinery to the Netherlands whose cash reserves in this country are enormous; 15,000 pieces of equipment to Belgium and Luxembourg; 14,000 to Czechoslovakia; 21,000 to Denmark; 212,000 to France; 8,900 to Greece; 12,000 to Norway; 115,000 to Poland; 36,000 to Yugoslavia; 20,000 to the Baltic States; and 10,000 to Italy. In addition there is listed 13,000 tons of spare parts to repair machinery in Europe while our American farmers are using baling wire to hold their equipment together.

If this is the farm-machinery program of U. N. R. R. A., what are its other programs? How many hidden skeletons of this kind does it have in its closet? Let us bring them forth.

Mr. Speaker, our country has been called upon, through lend-lease, to contribute our wealth and our energies to an embattled world. No Member of this House begrudges the allocation of war materials to any nation that is actually engaged by participation in the war. I do, however, most vociferously protest the use of our funds for building a railroad in Mexico, draining swamps in Venezuela, paying Peruvians to reduce cotton acreage, and the squandering of \$78,000,000 in the jungles of Brazil on a rubber project that has given no returns. Our country has been called upon to furnish 73 percent of the sons to be used in the invasion of Europe. Through our energies and productivity, we have become the arsenal of democracy while global planners, whose pipe dreams have never been equalled in world history, have spread our wealth as a lush green carpet over the entire earth. We continue rationing of meat, Canada discontinues it. We play the role of Santa Claus to the entire world, forgetful of the American taxpayers who, for generations to come, will pay with sweat and sacrifice for this folly.

Mr. Speaker, the time has come for America to take its head out of the sand and face the reality that a group of starry-eyed globats are scattering to the four winds of heaven the substances accumulated by this Nation through 150 years of sweat, toil, and blood. How much longer, may I ask, are we to follow, as gullible children, these crystal-gazing Pied Pipers who lead us onward toward bankruptcy?

governmental agency to influence political trends in the United States.

Cordially,

ELMER DAVIS.

FEBRUARY 28, 1944.

HON. ELMER DAVIS,
Director, the Office of War Information,
Washington, D. C.

MY DEAR MR. DAVIS: Thank you very much for your prompt reply to my letter of February 22, with respect to the distribution by the British Ministry of Information of a leaflet containing a news story to the effect that the political opponents of President Roosevelt are ready to spend \$50,000,000 to defeat him should he run for another term.

This is such obvious propaganda that I am surprised the officials of the British Ministry of Information did not appreciate their unethical action in including this in the four-page leaflet distributed under the auspices of the British Government to the American soldiers as they arrived in England.

I note this was sent to Great Britain by one of the news agencies. Could you give me the name of the news agency and likewise let me know whether the O. W. I. approved sending this dispatch abroad? Furthermore, would you be kind enough to send me a copy of this leaflet and future leaflets as they are distributed to the American troops?

Thanking you, I am,
Cordially yours,

HARRY F. BYRD.

FEBRUARY 29, 1944.

HON. HARRY F. BYRD,
United States Senate,
Washington, D. C.

DEAR SENATOR BYRD: I am informed that the agency which sent the news story about the alleged raising of \$50,000,000 to defeat the President, should he run for another term, was the British United Press. As for your question, Whether the O. W. I. approved sending this dispatch abroad? I am a little at loss to understand it. We have, of course, no right to approve or disapprove any dispatches sent abroad by news agencies, nor do we in ordinary course have any knowledge of their contents until they are seen in print by our offices overseas.

We should be glad to try to obtain for you any future leaflets distributed to American troops, but suggest that delay might be obviated if you applied directly to the office of the British Ministry of Information in the Embassy here, from whom we should have to get them.

Cordially,

ELMER DAVIS,
Director.

MARCH 3, 1944.

THE BRITISH UNITED PRESS, LTD.,
Washington, D. C.

(Care of the United Press.)

DEAR SIR: Attached is a copy of a letter I have received from Mr. Elmer Davis, Director of the Office of War Information.

Will you kindly inform me from what source you obtained the report which was published in the British papers and then republished in the leaflet distributed to American troops arriving abroad, as follows:

"Roosevelt's opponents are ready to spend \$50,000,000 to beat him if—as they assume—he makes a fourth-term bid for President at the November elections."

Thanking you, and with best wishes, I am,
Cordially yours,

HARRY F. BYRD.

MONTREAL, CANADA, March 15, 1944.

Senator HARRY F. BYRD,
United States Senate, Washington, D. C.

DEAR SENATOR BYRD: As your Washington office probably informed you, I made a trip to New York and Washington last week in

connection with the British United Press dispatch which appeared in the British press in January estimating that \$50,000,000 would be spent in attempt to defeat President Roosevelt for a fourth term.

I found that this story was written by one of our staff writers and that the \$50,000,000 estimate was his own.

It is a violation of our traditional news policy for any correspondent to use his own estimate in a matter of this kind and I can assure you that the correspondent in question has been properly reprimanded so that nothing of this sort is likely to happen again.

With best wishes, I am,
Sincerely,

R. W. KEYSERLINGK,
Managing Director,
British United Press, Ltd.

Mr. BYRD. Mr. President, I now want to call attention to another piece of political propaganda sent out by one of the agencies of the Federal Government at the expense of the United States taxpayers and printed and mailed under Government frank, but the worst of it is that it was sent to 890 local war price and rationing boards in an official communication.

This quite lengthy article of political propaganda was signed by G. C. Adams, Social Circle, Ga., and concludes with these words:

Let's lay aside our mulligrubs, and get on our knees and thank God for Roosevelt and his N. R. A., O. P. A., A. A. A., and F. H. A.

I immediately took up the matter with Mr. Chester Bowles, Administrator of the Office of Price Administration, and received a letter in reply, in which he admits that this article was sent from the Atlanta office under the official stationery of the O. P. A. He has imposed upon the person who sent out the article the punishment of requiring him to pay the cost of the publication. As a matter of fact, I think any employee of the Government who would so abuse the franking privilege as to send out such an article as this as an official communication should be dismissed from the public service.

I am glad, however, that Mr. Bowles states in his letter that he is using this example again to caution his staff in Washington and in the field that the operation of price control, rationing, and rent control must be kept completely free of politics.

This is but another instance of the abuse of the franking privilege by the thousands of branch and local offices of the different bureaus of the Government. It recalls the fact that not long ago an article was sent out under Government frank attacking the Senator from Georgia [Mr. GEORGE], the Senator from Tennessee [Mr. McKELLAR], and myself because of a stand we took in reducing an appropriation which was resented by the employees of this agency of the Government.

I ask unanimous consent to insert as a part of my remarks the letter I received from a member of a rationing board in Virginia, in which he enclosed the circular in question. For obvious reasons I have withheld this person's name and address.

There being no objection, the letter was ordered to be printed in the RECORD, as follows:

FEBRUARY 28, 1944.

DEAR SENATOR BYRD: In serving as chairman of the war price and rationing board, I see most of the printed matter sent out by O. P. A. I am enclosing a recent circular which was received at our rationing board office, in Government franked envelope, which smells to high heaven of politics.

In passing this along to you, I call your attention to the last paragraph of the circular.

The letter was mailed out of Atlanta office of O. P. A. I would say that most of the Eastern and Southern States rationing boards received it. It is quite possible that it was given national prominence.

Most of the printed matter of this nature is consigned to the waste basket, but I thought you might be interested in this particular one.

Mr. BYRD. Mr. President, I also ask unanimous consent to have printed in the RECORD my letter to Mr. Bowles and his reply thereto.

There being no objection, the letters were ordered to be printed in the RECORD, as follows:

FEBRUARY 29, 1944.

HON. CHESTER BOWLES,
The Office of Price Administration,
Washington, D. C.

MY DEAR MR. BOWLES: It has just been called to my attention that the enclosed letter was mailed out of the Atlanta office of the Office of Price Administration in a Government franked envelope.

Is it possible that your organization is disseminating political propaganda such as this at Government expense?

I would appreciate your advice as to who paid for the printing of this letter and as to whether it has been generally distributed over the country.

Cordially yours,

HARRY F. BYRD.

THE HONORABLE HARRY F. BYRD,
United States Senate,
Washington, D. C.

DEAR SENATOR BYRD: Thank you very much for calling to my attention the reprint of a letter to the Atlanta Journal, which our Atlanta office had mailed out.

Frankly, this came to me as very much of a shock. An investigation has disclosed the following facts:

This letter to the editor appeared in the Atlanta Journal February 3. On February 4 the Atlanta regional information executive directed the Office for Emergency Management to reprint 3,000 copies to be included with the weekly letter that the regional O. P. A. office sends to its 890 local war price and rationing boards. The entire printing was used for this mailing within the organization. The Atlanta office distributed no copies to the public, and none outside its region. The printing cost \$8.84.

Because the letter contained figures showing increases in farm income in the last 10 or 12 years, the Atlanta regional information executive thought that it would be of interest to local boards.

However, it is apparent that the letter might be interpreted to have political implications, and politics is none of O. P. A.'s business. Obviously, the order to print the relatively few copies that were run off was a serious error of judgment.

I have directed that the man responsible for the printing shall pay the bill himself so that there will be no expense to the Government. In addition, I am using this example again to caution our staff, in Washington and in the field, that the operation of price

control, rationing, and rent control, must be kept completely free of politics.

Again, thank you for your courtesy in calling this to my attention.

Sincerely,

CHESTER BOWLES,
Administrator.

Mr. BREWSTER. Mr. President, will the Senator yield?

Mr. BYRD. I yield.

Mr. BREWSTER. I should like to ask the Senator from Virginia a question. As I understand, the British agencies involved have admitted now the utter error of the statement in question, and that it was without foundation. Does the Senator know whether any steps have been taken or are to be taken to see to it that these erroneous reports are corrected?

Mr. BYRD. I will say to the Senator from Maine that I do not know of any steps that have been taken along that line. The item was sent by the British United Press, and I received a letter from the British United Press, as follows:

As your Washington office probably informed you—

The letter was sent to me from Montreal, Canada—

I made a trip to New York and Washington last week in connection with the British United Press dispatch which appeared in the British press in January estimating that \$50,000,000 would be spent in attempt to defeat President Roosevelt for a fourth term.

I found that this story was written by one of our staff writers and that the \$50,000,000 estimate was his own.

It is a violation of our traditional news policy for any correspondent to use his own estimate in a matter of this kind and I can assure you that the correspondent in question has been properly reprimanded so that nothing of this sort is likely to happen again.

Mr. BREWSTER. Has the Senator from Virginia inquired from Mr. Elmer Davis as to whether or not he would take appropriate steps to see that there was inserted in the Army publication in Great Britain which goes to our troops an authoritative statement summarizing what the Senator has found?

Mr. BYRD. I will say to the Senator that I asked Mr. Davis to do that, and he writes me:

I am quite satisfied that the incident represents a mistake by an editor who proved to be more newspaperman than diplomat, and that it was not, by any stretch of the imagination, a studied attempt by any British governmental agency to influence political trends in the United States.

Mr. BREWSTER. Would not good faith be shown by a readiness and willingness to give to our soldiers in Great Britain a correction?

Mr. BYRD. I entirely agree with the Senator, and I will suggest to Mr. Davis that such action be taken.

Mr. BREWSTER. I think it would be most appropriate.

NORTH DAKOTA LEADERSHIP IN FOURTH WAR LOAN DRIVE

Mr. LANGER. Mr. President, I am very proud to bring to the attention of the Senate the record of the State of North Dakota in the fourth war-loan drive. I hold in my hand an article which appeared in the Dunseith Journal

for March 23, in which the war-loan record of the State of North Dakota is stated. The article reads as follows:

NORTH DAKOTA TOPPED THE NATION IN FOURTH WAR LOAN

North Dakota topped the Nation in percent of series E War bond quota reached during the fourth war-loan campaign, according to an official release by the Treasury Department giving the final report of the fourth war loan.

The three leading States in percent of series E quota are: North Dakota, 181 percent; Wyoming, 152 percent; Iowa, 147 percent. North Dakota ranked second in percent of total quota. The three leading States are: Mississippi, 154 percent; North Dakota, 153 percent; Minnesota, 144 percent. Our State was also in second place in percent of individual quota reached. The three leading States are: Florida, 148 percent; North Dakota, 139 percent; Oregon, 135 percent.

R. R. Wolfer, executive director, North Dakota war finance committee, in a statement today said that this outstanding record was made possible by the patriotic service of more than 12,000 volunteer workers throughout the State serving on county and local war finance committees. He said that the help and cooperation of the schools of the State was also an important factor in the success of the campaign.

Mr. Wolfer pointed out that North Dakota's War bond sales record during the fourth war-loan campaign, which ranked North Dakota first or second in all three quotas, places our State at the very top among the States of the Nation. He further stated that this record proves the determination of North Dakota people to "back the attack" to a finish. He said that our people were ready and willing to make all their War-bond quotas, not only in the expanded war-loan drives, but also in the regular month-to-month campaigns.

The North Dakota series E, F, and G War bond quota for March is \$2,600,000.

Mr. President, I wish to say that North Dakota's record was made despite the fact that the administration has not placed a single war industry within the borders of our State. North Dakota is the only State in the Union which has not received one war industry during the present war.

SYNTHETIC LIQUID FUELS—CONFERENCE REPORT

Mr. O'MAHONEY submitted the following report:

The committee of conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows: That the Senate recede from its disagreement to the amendment of the House to the text of the bill and agree to the same with an amendment as follows: In lieu of the matter proposed to be inserted by the House amendment insert the following:

"That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than five years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, and one or more demonstration plants to produce liquid fuels from agricultural and forestry products, with all facilities and accessories for the manufacture, purification, storage, and distribution of the prod-

ucts. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this Act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products. Any activities under this Act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture.

"Sec. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

"(a) to conduct laboratory research and development work, and with pilot plants and semiworks plants to make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs, necessary to determine the best demonstration plant designs and conditions of operation;

"(b) to acquire, by purchase, license, lease for a term of years or less, or donation, secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to acquire by purchase, lease for a term of years or less, or donation, land, and any interest in land (including easements and leasehold interests), options on real or personal property, and plants and their facilities; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: *Provided, however*, That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

"(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization or any educational institution he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

"(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation, in effectuating the purposes of this Act.

"Sec. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, subject to approval by Congress, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this Act; and he shall have authority to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act: *Provided*, That such licenses are consistent with the terms of the agreements by which such patent rights are acquired. No patent acquired by the Secretary of the Interior under this Act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process covered by such patent, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

"SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this Act.

"SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this Act. The authority and duties of the Secretary of the Interior under this Act shall be exercised through the Bureau of Mines of the Department of the Interior.

"SEC. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this Act."

And the House agree to the same.

That the Senate recede from its disagreement to the amendment of the House to the title of the bill, and agree to the same with an amendment as follows:

Amend the title to read as follows: "An Act authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shales, agricultural and forestry products, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes."

And the House agree to the same.

JOSEPH C. O'MAHONEY,

CHAN GURNEY,

Managers on the part of the Senate.

JENNINGS RANDOLPH,

JOHN M. ROBISON,

Managers on the part of the House.

Mr. O'MAHONEY. I ask unanimous consent for the present consideration of the report.

The PRESIDING OFFICER. Is there objection?

There being no objection, the Senate proceeded to consider the report.

Mr. LANGER. Mr. President, as I understand the bill, it deals with the development of the coal and other fuel resources of the West.

Mr. O'MAHONEY. The bill is the synthetic-fuels bill.

Mr. LANGER. I believe it is the bill the passage of which we have been endeavoring to secure for some time.

Mr. O'MAHONEY. It has been under consideration in the last Congress and in the present Congress, and the Senator from North Dakota has been very much interested in securing its passage.

The PRESIDING OFFICER. The question is on agreeing to the report.

The report was agreed to.

INCREASED POSTAL AND OTHER RATES UNDER NEW TAX LAW

Mr. LANGER. Mr. President, I rise to bring to the attention of the Senate the manner in which a part of the new tax bill which went into effect yesterday will penalize the people who patronize the post offices, which are owned by the people themselves, and will favor the banks, the express companies, and the monopolies. In the West we have a saying, "You don't have to eat a whole beef to find out whether it is tainted." Therefore, Mr. President, without mentioning the major defects of the tax bill which has just gone into effect, I quote an advertisement published in a North Dakota newspaper. It was published in the March 22, 1944, issue of the Bismarck Tribune, on page 8. The advertisement was inserted by the Dakota National Bank & Trust Co., and is entitled "Bank

Money Orders Cost Less." It reads as follows:

Bank money orders cost less; and as of March 26, 1944, the saving will be even greater. Here's the new schedule of postal money orders as compared to the cost of our bank money orders.

Amount	Postal money order	Our bank money order
\$0.01 to \$2.50	\$0.10	\$0.05
\$2.51 to \$5	.14	.05
\$5.01 to \$10	.19	.10
\$10.01 to \$20	.22	.10
\$20.01 to \$40	.25	.10
\$40.01 to \$50	.30	.10
\$50.01 to \$80	.30	.15
\$80.01 to \$80	.34	.15
\$80.01 to \$100	.37	.15

¹ \$0.10 per hundred or fraction.

Bank money orders cost less, they are available in whatever amount is required, a receipt is issued for your record, and the canceled money order is retained in our files for future reference. When you need money orders come to the Dakota National Bank, "the friendly bank." Affiliated with Northwest Bancorporation; member, Federal Deposit Insurance Corporation.

From the schedule which appears in the advertisement we find that a money order for an amount between 1 cent and \$2.50 will cost, if purchased at a post office, 10 cents; but if it is purchased at a bank in the same town, the cost will be 5 cents.

Likewise, under the new tax measure, if one buys at a post office a money order for an amount anywhere between \$2.51 and \$5, the cost will be 14 cents, whereas one can go to any bank in that town and buy a money order in the same amount for 5 cents. If a money order is bought at a post office, which is owned by the people, for an amount between \$5.01 and \$10, it will cost 19 cents, but one can go to any bank and buy it for 10 cents. If the money order is for an amount between \$10.01 and \$20, if one buys it at a post office, the cost is 22 cents, but one can go to any bank and buy it for less than half, or for 10 cents. Under the new tax bill, of which some people are so proud, if one buys a money order for an amount anywhere between \$20 and \$40 at a post office, it will cost 25 cents, but the same money order at any local bank will cost 10 cents. If a person buys a money order for an amount anywhere between \$40.01 and \$50 at a post office, it will cost 30 cents, but it can be bought at a bank for 10 cents. A money order for an amount between \$60 and \$80 will cost at a post office 34 cents, but at a bank the cost will be 15 cents. A money order for an amount anywhere between \$80 and \$100 will cost 37 cents at a post office, but will cost only 15 cents at a bank.

So, Mr. President, we see that the law passed by the Congress is putting our own Post Office Department out of business insofar as the issuing of money orders is concerned. The rates charged are so high that, as I said before, a money order for an amount anywhere between \$80 and \$100 will cost 37 cents at a post office, but will cost only 15 cents at a bank. So there will be a saving of 22 cents to the patron of the bank. I say

that the increased postal rates will result in having the business diverted from the post offices to the banks insofar as money orders are concerned.

Mr. President, under the new tax rates, registration fees are increased approximately one-third, and insurance and c. o. d. fees are doubled. The local letter rate has been increased from 2 to 3 cents an ounce. The domestic air-mail rate has increased from 6 to 8 cents an ounce.

All of us are familiar with the terrific fight put up a few years ago against the parcel post by the express companies; yet we find that every parcel post package will require at least 1 cent more in postage, under the new tax bill, which requires an increase of 1 cent or 3 percent, whichever is the greater, and this at a time when the express companies are making more money than ever before in their history, and when we have the situation described a few moments ago by the distinguished junior Senator from Vermont [Mr. AIKEN].

This Congress, which refused to tax future issues of tax exempt securities and was so eager to pass the \$9,000,000,000 Ruml income tax forgiveness, and which also refused to limit salaries to \$25,000, increased the tax on electric light bulbs 15 percent, so light bulbs, which formerly cost the laboring man or the farmer \$1, will now cost him \$1.15. Charges for telephone services will increase to another 5 percent on local service, and 15 percent more on toll calls.

Mr. President, I rise to congratulate myself for having voted against this tax bill, and to express the hope that when the people of this country really understand what a miserable tax bill was passed by this body, they will more closely watch future tax legislation.

When this tax bill was under consideration I said that more millionaires would be created in World War No. 2 than were created in World War No. 1. I said then that the large corporations were making more money after taxes were paid than ever before in the history of America, and I repeat that assertion today. The poor people, and not the rich, are the ones who are paying for this war.

FIRST DEFICIENCY APPROPRIATIONS

The Senate resumed the consideration of the bill (H. R. 4346) making appropriations to supply deficiencies in certain appropriations for the fiscal year ending June 30, 1944, and for prior fiscal years, to provide supplemental appropriations for the fiscal year ending June 30, 1944, and for other purposes.

The PRESIDING OFFICER. The clerk will proceed to state the amendments reported by the Committee on Appropriations.

The first amendment of the Committee on Appropriations was, under the heading "Title I—General appropriations—legislative," on page 2, after line 2, to insert:

SENATE

For the payment to Elysabeth C. Barbour and Sharon Barbour, daughters, and Warren Barbour, son, of W. Warren Barbour, late a Senator from the State of New Jersey, \$10,000, as follows: One-third thereof to Elysabeth C.

Barbour, and two-thirds to Frederick K. Barbour and Charles S. McVeigh, legal guardians of Sharon Barbour and Warren Barbour, minors.

The amendment was agreed to.

The next amendment was, on page 2, after line 10, to insert:

For payment to Cornelia Morton McNary, widow of Charles L. McNary, late a Senator from the State of Oregon, \$10,000.

The amendment was agreed to.

The next amendment was, on page 2, after line 13, to insert:

For payment to Marie K. Van Nuys, widow of Frederick Van Nuys, late a Senator from the State of Indiana, \$10,000.

The amendment was agreed to.

The next amendment was, under the subhead "House of Representatives," on page 3, line 14, after the numeral "3", to insert "and McEvoy versus Peterson as audited and recommended by the Committee on Elections Numbered 2."

The amendment was agreed to.

The next amendment was, on page 3, after line 20, to insert "Hugh Peterson, \$581.50."

The amendment was agreed to.

The next amendment was, on page 3, line 22, after the words "In all", to strike out "\$8,000" and insert "\$8,581.50."

The amendment was agreed to.

The next amendment was, under the subhead "Government Printing Office", on page 5, line 11, after the words "ceiling price", to insert "orders and"; in line 13, after the word "such", to insert "orders and"; and in line 16, before the word "schedules", to insert "orders and."

The amendment was agreed to.

The next amendment was, under the heading "Executive Office of the President—Office for Emergency Management", on page 6, after line 18, to insert:

Office of Defense Transportation: The funds appropriated to the Office of Defense Transportation for the fiscal year 1944 shall be available for the employment of a Director at \$12,000 per annum.

The amendment was agreed to.

The next amendment was, under the heading "Independent executive agencies", on page 7, after line 7, to insert:

OFFICE OF EDUCATION

Education and training, defense workers (national defense): For an additional amount for payments to States, and so forth, fiscal year 1944, for the cost of vocational courses in food production and conservation, mechanics, farm-machinery repair, and farm-labor training of less than college grade, as provided in paragraph 3, under this head in the Federal Security Agency Appropriation Act, 1944, \$4,000,000.

The amendment was agreed to.

The next amendment was, under the subhead "Federal Works Agency", on page 8, line 12, after "and 1541)", to strike out "\$127,500,000" and insert "\$112,500,000."

The amendment was agreed to.

The next amendment was, on page 9, line 2, after the word "in", to insert "Senate Document Numbered 172, and"; and in line 4, after the name "Congress", to strike out "\$3,589.30" and insert "\$7,682.92."

The amendment was agreed to.

Mrs. CARAWAY. Mr. President, I should like to take a few minutes to speak on this bill as the representative of American women. The appropriation for the Federal Works Agency which is included in the deficiency appropriation bill is of deep concern to them because those funds will make possible the continuance and expansion of Federal aid to our nursery schools and child-care centers for the children of working mothers.

Today there are more than 5,500,000 women with children under 14 employed in America. Those women cannot do their best work, and many of them cannot even stay on the job, unless they have some assurance that their children are being adequately cared for.

The funds allocated to date to the Federal Works Agency for the War Public Works and War Public Services Program have made possible the establishment by local communities of 2,243 projects caring for 65,772 children. It is clear that this program needs to be expanded considerably to meet the needs of working mothers. Applications for 302 new projects have been held up for weeks because the funds of the Federal Works Agency were all allocated.

As Senators know, the President requested Congress to grant an additional appropriation of \$150,000,000 to the Federal Works Agency. It is a great disappointment to me that these funds have been so seriously cut. The House reduced the appropriation to \$127,500,000. The bill which is now before us further reduces the amount to \$112,500,000.

There is another and even more serious weakness in the bill before us to which I should like to call attention. There is at present a limitation of \$40,000,000 on the funds which can be spent by the Federal Works Agency for maintenance and operation of facilities. That limitation applies to the funds which were authorized by Congress for the Federal Works program after July 1, 1943. If that limitation remains in the law the child-care centers will have to close, regardless of how much money we appropriate.

General Fleming testified before the House Appropriations Committee that they have already made allocations of approximately \$30,000,000 for maintenance and operation of projects since July. He said "if the limitation remains in the law, we would be unable to continue essential service projects or to approve any in new locations."

If that limitation is not removed, therefore, the Federal Works Agency will not be able to use the funds we appropriated for it to keep the present child-care centers open for another year. It will not be able to open the 300 new centers which have already been certified as essential to our war effort.

I wonder if Senators realize what that would mean. It would mean thousands of women leaving their war jobs at a time when our War Production Board has just announced that our war output is behind schedule. It would mean thousands of more door-key children on our streets.

I should like to see inserted in this bill a provision to remove the \$40,000,000 lim-

itation so that the child-care program which is so urgently needed in all our war areas can go ahead without further loss of time.

In conclusion, I should like to read a letter which six women Members of the House submitted to the House Appropriations Committee when this matter was before that body.

FEBRUARY 24, 1944.

HON. CLARENCE CANNON, *Chairman*.

MR. CHAIRMAN: As of course you know, under the wartime child-care program funds are allotted for assistance in the operation of facilities for the care of children whose mothers are employed in jobs essential to the war effort. Local communities participate in the cost of the service to the extent that funds are available, and the parents pay a fee which must cover, at least, the cost of food. As of January 31, 1944, a total of \$20,204,565 of Lanham Act funds had been allotted for wartime child-care services. As of February 9, the last date for which a report is available, there were in operation 1,431 nursery schools with an enrollment of 37,439 preschool children and 812 centers with an enrollment of 28,333 school-age children. This makes a total of 2,243 centers with an enrollment of 65,772.

You have under consideration before your committee a request from the Director of the Budget for an appropriation of \$150,000,000 to the Federal Works Agency for War public works. An important part of this fund is for the continuation and expansion of the child-care program.

We want to call to your attention the urgency of this program because of the vast number of women now in industry and the need for more than 1,000,000 additional women workers by July 1.

At the present time, only 65,772 children are being taken care of in 2,243 projects. This does not begin to meet the existing need, as evidenced by the fact that four out of five women hired today leave their jobs because of home problems. One of the most common of these is lack of adequate care for these children. The War Manpower Commission estimates that one out of every seven women workers has a child needing care. This means that at least 142,000 more children than at the present will need care by July 1 if the recruitment program is to be successful. As you know, an increasing number of women with small children are being forced to seek employment as fathers are drafted into the armed forces.

The health and safety of our children, as well as the achievement of our war production goals, depend on speedy provision of the necessary funds.

The program at present is at a standstill. No new projects can be opened even though applications for 302 child-care projects from local communities, certified as essential to the war effort, are pending. Facilities cannot be provided for the children in these areas and the existing projects will be forced to close as their grants expire unless this appropriation is granted at once.

A further step is necessary to the fulfillment of this program. The limitation of \$40,000,000 imposed by act of Congress of July 15, 1943, on the amount of funds permitted to be used for maintenance and operation of these war services should be lifted. Allocation of funds to the child-care projects already approved and pending would bring the total allocation up to the limit imposed. Therefore, the failure to remove this limitation would mean a total collapse of the child-care program.

Therefore, we women members of Congress, assume the responsibility of speaking for the millions of working mothers of our country and of impressing upon you the need for action. Women cannot do their best work

to erect a sound military policy for the United States, not the policy of an aggressor nation but a policy to make us safe and secure and go very, very far toward keeping us out of other wars. We have never made an effort of that kind following any of our wars.

Again, in my humble judgment, our failure to do so has cost the United States and its people billions and billions of dollars and tens of thousands of lives. Let us hope that we are learning lessons during this war and that we will learn more lessons when it is over. When we get a comprehensive view finally of this world and America's position in it, we should then adopt a comprehensive military policy for the United States that will keep us safe and secure.

Mr. MICHENER. Mr. Speaker, will the gentleman yield?

Mr. WADSWORTH. I yield to the gentleman from Michigan.

Mr. MICHENER. I notice the resolution provides "that it shall be the duty of the committee to investigate any matters relating to the post-war military requirements of the United States." As I suggested to the gentleman in the Rules Committee, would it not be well to offer an amendment to investigate post-war policies and requirements? Does the gentleman from New York believe that the resolution is broad enough and that requirements will be interpreted to include policy?

Mr. WADSWORTH. Personally, I have no objection to an amendment such as proposed by the gentleman from Michigan, but I do believe that the general expression in this resolution, including the use of the expression "military requirements," contemplates, for example, that military requirements are governed by policy.

Mr. MICHENER. That would probably be true, but it occurred to me that it might be rather difficult for any committee to even conjecture as to what the requirements will be after the war until—quoting the gentleman's speech a few moments ago—we know the kind of a world in which we shall be living. It would be entirely proper, feasible, and possible to consider a peacetime military policy.

Mr. WADSWORTH. I agree with the gentleman from Michigan. I think the resolution in its general phraseology makes it clear that the duty of this committee is to study policy. Of course, policy is connected with military requirements, whatever they may be in the future. I have no objection to an amendment of that sort, but I do not regard it as necessary.

Mr. MARTIN of Iowa. Mr. Speaker, will the gentleman yield?

Mr. WADSWORTH. I yield to the gentleman from Iowa.

Mr. MARTIN of Iowa. I am glad to hear the gentleman's statement about the planning of adequate defense to match the situation in foreign affairs, or our relationship to other countries. For instance, I call to mind the tardiness of our approach to preparedness in the years 1939 and 1940. A policy committee such as this would lead us to start preparedness to match the dangers in the

world a little ahead of our awakening in 1939, I take it.

Mr. WADSWORTH. And a similar awakening in 1917.

Mr. MARTIN of Iowa. And, similarly, the post-war period.

Mr. WADSWORTH. And 1898.

Mr. MARTIN of Iowa. Yes. We have never been adequately prepared for any crisis that has yet come on us.

Mr. WADSWORTH. We have not.

The SPEAKER pro tempore. The time of the gentleman from New York has expired.

Mr. COLMER. Mr. Speaker, I move the previous question on the resolution.

The previous question was ordered.

The resolution was agreed to.

A motion to reconsider was laid on the table.

PERMISSION TO ADDRESS THE HOUSE

Mr. DICKSTEIN. Mr. Speaker, I ask unanimous consent that on tomorrow, at the conclusion of the legislative program of the day and following any special orders heretofore entered, I may be permitted to address the House for 30 minutes.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from New York?

There was no objection.

SELECT COMMITTEE ON POST-WAR MILITARY POLICY

Mr. COCHRAN. Mr. Speaker, by direction of the Committee on Accounts, I submit a privileged resolution and ask its immediate consideration.

The Clerk read House Resolution 486, as follows:

Resolved, That the expenses of conducting the study and investigation authorized by House Resolution 465, of the Seventy-eighth Congress, incurred by the Committee on Post-War Military Policy, acting as a whole or by subcommittee, not to exceed \$25,000, including expenditures for the employment of clerical, stenographic, and other assistants, shall be paid out of the contingent fund of the House on vouchers authorized by such committee or subcommittee thereof conducting such study and investigation or any part thereof, signed by the chairman of the committee or subcommittee, and approved by the Committee on Accounts.

SEC. 2. The official stenographers to committees may be used at all hearings held in the District of Columbia unless otherwise officially engaged.

The resolution was agreed to.

A motion to reconsider was laid on the table.

Mr. COCHRAN. Mr. Speaker, I ask unanimous consent to extend my remarks in the RECORD at this point.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from Missouri?

There was no objection.

Mr. COCHRAN. Mr. Speaker, the Committee on Accounts unanimously agreed this morning to recommend that \$25,000 be provided for the Post-war Military Policy Committee. The gentleman from New York, Congressman WADSWORTH, the author of the resolution which created this select committee, as well as the gentleman from Virginia, Congressman WOODRUM, who has been named chairman of this select committee attended the hearing and outlined the

purposes and objectives of the study.

The Committee on Post-war Military Policy is to be composed of 23 Representatives, including 7 members of the Committee on Military Affairs, 7 members of the Committee on Naval Affairs, and 9 Representatives who are not members of either such committee.

Under the resolution it is the duty of the committee to investigate all matters relating to post-war military requirements of the United States. This will involve gathering information and preparing plans and suggestions from informed sources with respect to military requirements.

It will also be the duty of the committee to study the plans and suggestions received and to report to the House from time to time the results of findings made and conclusions reached.

The select committee will serve as a forum where members of the armed services directly affected, as well as individuals and private organizations, can come and offer suggestions. Many problems such as the policy relative to the disposition of the immense investment the Government has put into plants as well as other large projects, and the procedure and principles we should employ to recruit our armies in the future, will be considered by this select committee. They also plan to make a study of educational institutions and their part in the military program in the future.

It was pointed out at the hearing that immediately after the First World War there was a mad scramble to demobilize which resulted in the maladjustment of our economic structure. One of the objectives of the committee will be to formulate plans which will prevent a recurrence of the chaotic condition which characterized demobilization at the conclusion of the First World War.

This is a joint committee and it has simply recommendatory powers. It will have no authority to report bills but will simply be confined to recommending appropriate action to effect the results desired.

Both the gentleman from New York [Mr. WADSWORTH] and the gentleman from Virginia [Mr. WOODRUM] stated that they did not contemplate a great deal of expense. The committee does not propose to travel but will simply conduct the study and investigation as provided in the original resolution. It was felt that no large expenditure of money would be necessary and that an appropriation of \$25,000 would be sufficient.

SYNTHETIC LIQUID FUELS FROM COAL AND OTHER SUBSTANCES

Mr. RANDOLPH submitted the following conference report and statement on the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal and other substances in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes:

CONFERENCE REPORT

The committee of conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1243) authorizing the construction and operation

of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the Senate recede from its disagreement to the amendment of the House to the text of the bill and agree to the same with an amendment as follows: In lieu of the matter proposed to be inserted by the House amendment insert the following:

"That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than five years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, and one or more demonstration plants to produce liquid fuels from agricultural and forestry products, with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this Act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products. Any activities under this Act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture.

"SEC. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

"(a) to conduct laboratory research and development work, and with pilot plants and semiworks plants to make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs, necessary to determine the best demonstration plant designs and conditions of operation;

"(b) to acquire, by purchase, license, lease for a term of years or less, or donation, secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to acquire by purchase, lease for a term of years or less, or donation, land, and any interest in land (including easements and leasehold interests), options on real or personal property, and plants and their facilities; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: *Provided, however,* That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

"(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization or any educational institution he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

"(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation, in effectuating the purposes of this Act.

"SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amor-

tization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State Government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, subject to approval by Congress, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this Act; and he shall have authority to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act: *Provided,* That such licenses are consistent with the terms of the agreements by which such patent rights are acquired. No patent acquired by the Secretary of the Interior under this Act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process covered by such patent, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

"SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this Act.

"SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this Act. The authority and duties of the Secretary of the Interior under this Act shall be exercised through the Bureau of Mines of the Department of the Interior.

"SEC. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this Act."

And the House agree to the same.

That the Senate recede from its disagreement to the amendment of the House to the title of the bill, and agree to the same with an amendment as follows:

Amend the title to read as follows:

"An Act authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shales, agricultural and forestry products, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes."

And the House agree to the same.

JENNINGS RANDOLPH,

JOHN M. ROBSON,

Managers on the part of the House.

JOSEPH C. O'MAHONEY,

CHAN GURNEY,

Managers on the part of the Senate.

STATEMENT

The managers on the part of the House at the conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, submit the following statement in explanation of the effect of the action agreed upon by the conferees and recommended in the accompanying conference report:

The House amendment to the text struck out all of the Senate bill after the enacting clause. The committee of conference recommends that the Senate recede from its disagreement to the amendment of the House, with an amendment which is a substitute for both the Senate bill and the House amendment, and that the House agree to the same.

The substantive differences between the House amendment and the proposed con-

ference substitute are noted in the following statement:

Both the Senate bill and the House amendment authorized the Secretary of the Interior to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances. The House amendment also specifically authorized the Secretary to construct, maintain, and operate one or more demonstration plants to produce liquid fuels from agricultural and forestry products. The conference agreement retains this provision of the House amendment, but provides that any activities under the act relating to the production of fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture. The Department of Agriculture has been for many years engaged in studying and experimenting with the production of such fuels, and it appears wise to provide that any program carried out under this act relating to fuels from agricultural and forestry products should be fully coordinated and integrated with the existing program of that Department. The Senate bill contained a provision, which was not in the House amendment, which limited the authority of the Secretary of the Interior with respect to the construction, maintenance, and operation of demonstration plants to a period of not more than 5 years. The conference agreement retains this provision.

Section 2 (a) of the Senate bill contained a provision, which was not in the House amendment, specifying that the Secretary of the Interior, in conducting research and development work, is authorized, with pilot plants and semiworks plants, to make engineering studies in order to ascertain lowest costs. The conference agreement retains this provision.

Section 2 (b) of the House amendment included acquisition by license among the methods by which the Secretary is authorized to acquire patent rights and other rights, and would have authorized the acquisition of interests in lands by condemnation, among other methods. The conference agreement retains the authority to acquire patent and other rights by license, but eliminates the authority to acquire land by condemnation. The conference agreement also retains a provision in this paragraph which was in the Senate bill, but not in the House amendment, and which provides that the maximum quantity of land or any interest therein, or any other property, acquired under the act shall not exceed that necessary to carry out the purposes of the act.

Section 2 (c) and (d) of the House amendment contained provisions, not in the Senate bill, specifically including educational institutions among the organizations which the Secretary is authorized to utilize and with which he is authorized to cooperate. The conference agreement follows the House amendment in this respect.

The House amendment contained a provision, which was not in the Senate bill, and which would have exempted leases made under this act from the provisions of sections 321 and 322 of the act of June 30, 1932, as amended, and would have provided that such leases could be made for a term of years notwithstanding section 3679 of the Revised Statutes, as amended, or any other provision of law. This provision is omitted from the conference agreement, as there appears to be no necessity or justification for exempting these leases from the provisions of sections 321 and 322, referred to above, and the earlier provisions of the bill specifically authorize leases to be made for a term of years.

The conference agreement retains a provision which was in the House amendment, but not in the Senate bill, and which provides that the authority of the Secretary to dispose of any lease or other property ac-

quired under the act shall be exercised subject to approval by Congress.

The House amendment contained a provision, which was not in the Senate bill, and which authorized the Secretary to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under the act, if such licenses are consistent with the terms of the agreements by which such patent rights are acquired. The conference agreement retains this provision of the House amendment. The Senate bill contained a provision, which was not in the House amendment, and which provided that no patent or patent rights acquired by the Secretary under the act should prevent any citizen of the United States or any domestic corporation from using any invention, discovery, or process to which such patent or patent rights related, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such citizen or corporation on account of such use. The conference agreement retains this provision in a modified form which makes it applicable only with respect to patents acquired by the Secretary of the Interior under the act. The purpose of this provision is to make available to the citizens and corporations of the United States the use of any inventions, discoveries, and processes which may be invented or discovered in operations under the act, and the use of other inventions, discoveries, and processes covered by patents which are acquired in their entirety by the Secretary under the act. It does not mean that when the Secretary uses a patent under a license from a private owner of such patent, the public will also be permitted to use the patent merely because the Secretary has been licensed to do so.

The conference agreement makes clerical changes in the title of the bill.

JENNINGS RANDOLPH,
JOHN M. ROBSION,

Managers on the part of the House.

Mr. RANDOLPH. Mr. Speaker, I ask unanimous consent for the immediate consideration of the conference report on the bill S. 1243.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from West Virginia?

Mr. MICHENER. Reserving the right to object, Mr. Speaker, this is a unanimous report. I notice the gentleman from Kentucky [Mr. ROBSION] is on his feet.

Mr. RANDOLPH. The gentleman from Michigan is correct. The gentleman from Kentucky [Mr. ROBSION] has signed the report. It is a unanimous report of the managers on the part of the House.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from West Virginia?

There was no objection.

Mr. RANDOLPH. Mr. Speaker, I ask unanimous consent that the statement be read in lieu of the report.

Mr. STEFAN. Reserving the right to object, Mr. Speaker, will the gentleman from West Virginia explain how agriculture comes into this picture, and explain that agricultural products can be used for producing synthetic liquid fuels?

Mr. RANDOLPH. I will gladly explain it, I may say to the gentleman from Nebraska, because we have retained what the House did at the time we considered the bill H. R. 3209.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from West Virginia?

There was no objection.

The Clerk read the statement.

Mr. RANDOLPH. Mr. Speaker, the conference report which is presented today is, I believe, of importance to the Members of the House. The House amendment to this bill struck out all of the Senate measure after the enacting clause and inserted a complete substitute, which we considered on the House floor, the bill being known as H. R. 3209. However, there were few differences of special importance between the House and the Senate versions. The conference agreement follows very largely the House amendment. There are some differences in substance from the measures, as we considered them in both Houses, to which I should like to refer.

The conference agreement retains the amendment offered by the gentleman from Texas [Mr. LANHAM], relating to the method by which the Secretary of the Interior is authorized to acquire patent and other rights and to acquire lands and interests in lands. The conference agreement eliminates the word "otherwise" from that portion of this amendment which relates to the acquisition of land. The effect of eliminating the word "otherwise" would be to eliminate the power of the Secretary to acquire land for the purposes of this act by condemnation.

The conference agreement also retains the amendment offered by the gentleman from Texas [Mr. LANHAM] which provides that licenses granted by the Secretary under patent rights acquired under the act must be consistent with the terms of the agreements by which such patent rights are acquired. It seems appropriate at this point to call attention to a provision in the conference agreement which was taken from the Senate bill. This provision, as it appears in the conference agreement, provides that no patent acquired by the Secretary under this act shall prevent any citizen or corporation of the United States from using any invention, discovery, or process covered by such patent, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such citizen or corporation on account of such use. The purpose of this provision is to make available to such citizens and corporations the use of any inventions, discoveries, and processes which may be invented or discovered in operations under the act, and also the use of other inventions, discoveries, and processes covered by patents which are acquired in their entirety by the Secretary under the act. It does not mean that when the Secretary is licensed to use a privately owned patent the public will also be permitted to use the patent merely because the Secretary is licensed to do so.

The gentleman from Illinois [Mr. SABATH], who is on his feet, has had much experience in connection with the subject of patent rights. I recall his special

interest in that provision at the time this legislation was under consideration.

Mr. SABATH. I was and still am interested that the Government be protected in every way and not be subjected to many claims by those who have acquired these patents. Is the bill now so worded that the rights of the Government will be safeguarded against any possible attack on the part of those gentlemen who by hook or crook may have obtained some of those patents from the men who actually made the inventions?

Mr. RANDOLPH. That provision is retained. The Senator from Vermont [Mr. AUSTIN] and the gentleman from Texas [Mr. LANHAM] had in mind just that result. I think both phases of the patent picture, the protection of the private individual and the corporation, and the protection of the Government, are taken care of by our agreement.

I think the importance of the agricultural picture as presented here in a question asked by the gentleman from Nebraska [Mr. STEFAN] is proper to bring to your attention at this time.

The agreement retains the amendment offered by the gentleman from Illinois [Mr. ANTON J. JOHNSON].

Mr. VOORHIS of California. Mr. Speaker, will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from California.

Mr. VOORHIS of California. I want to say to my distinguished colleague from West Virginia that, in my opinion, he has rendered our country an outstanding service in sponsoring this legislation. I predict the day will come when future generations of Americans will thank him with all their hearts for pioneering this work of developing liquid fuels from basic resources which we have in abundance here in our own country. Now I am very much interested in the provisions about the patents. Do I correctly understand the gentleman to say that assuming that some process is perfected or developed in the course of this work which the gentleman's bill is going to make possible, then that patent will be freely available for use by any person who desires to make use of it, under a proper license?

Mr. RANDOLPH. That is correct, any individual or corporation.

Mr. VOORHIS of California. That is in the bill as it now stands? I believe that to be very important and very right.

Mr. RANDOLPH. That is correct. The gentleman from California makes an observation which is important to the House, as we bring to final passage what we believe to be a most important measure, and I am deeply grateful to my friend for his gracious reference to my work.

The amendment offered by the gentleman from Illinois [Mr. ANTON J. JOHNSON] you will recall, was the subject of debate in the House during the consideration of this bill. That amendment specifically authorizes the construction and operation of one or more demonstration plants to produce liquid fuel from agricultural and forestry products.

In connection with this provision, the conference report provides that any activities under the act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture. The Department of Agriculture has carried on research and experimental work relating to the production of alcohol since 1906. In recent years, most of the work relating to the production of liquid fuels from agricultural products has been performed by the Bureau of Agricultural and Industrial Chemistry in the regional agricultural laboratory at Peoria, Ill., and most of the work relating to the production of fuels from forestry products has been done by the United States Forest Service in the Forest Products Laboratory, at Madison, Wis. It seems evident that any further experimental and demonstration work for the production of fuels from these products should be closely coordinated and integrated with the work of the Department of Agriculture.

Mr. CHIPERFIELD. Mr. Speaker, will the gentleman yield?

Mr. RANDOLPH. I yield to the gentleman from Illinois.

Mr. CHIPERFIELD. The amendment of the gentleman from Illinois [Mr. ANTON J. JOHNSON] is still in the bill in substantial form?

Mr. RANDOLPH. That is correct. There will be one or more demonstration plants using, as a base, agricultural or forestry products. All we have done is to have that program carried on in the Department of Agriculture where we have the experts and where the valuable work has been done, rather than in the Department of the Interior, although the language of the conference report calls for a cooperative effort in this connection.

Mr. CHIPERFIELD. It just puts it under the direction of the Department of Agriculture?

Mr. RANDOLPH. That is correct. The studies have been going on for many years. Experimentation and research in these subjects has been helpful.

Mr. STEFAN. Mr. Speaker, will the gentleman yield?

Mr. RANDOLPH. I yield.

Mr. STEFAN. We do not object to the Department of Agriculture experimenting in the making of fuel out of agricultural products. We believe it should remain in the Department of Agriculture, but we want to be assured that in this authorization bill, and it is merely an authorization bill inasmuch as no money is provided in it, that the agricultural and forestry products are protected in this legislation. And the gentleman assures us that agricultural products and forestry products are protected and will participate in whatever experiments are being made under the provisions of this legislation. Am I correct in that assumption?

Mr. RANDOLPH. The gentleman from Nebraska is correct. We further believe it and it is evident in the language reading as follows:

In connection with this provision, the conference report provides that any activities

under the act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture.

I think that is the viewpoint taken by the gentleman from Nebraska.

Mr. STEFAN. Yes; it is.

Mr. RANDOLPH. The conference agreement retains the amendment offered by the gentleman from Colorado [Mr. ROCKWELL]. That provision related to oil shale, as you remember, "or substance" added to the word "coal." The original Senate bill had simply contained the word "coal" and then used the words "and other substances." We specifically name oil shale in the agreement. Then there was an amendment which was included in the House amendment which was passed on the floor and which was offered by the gentleman from New Mexico [Mr. FERNANDEZ]. He wishes inserted the words "or any educational institution." We believe in going forward with these studies on a cooperative basis. Private individuals and corporations are authorized, or should be consulted, of course, and we believe that educational institutions in many instances have done valuable work and can be further used. For that reason that amendment has been retained in the bill in the agreement of the managers on the part of the House with the Senate.

The agreement also retains the amendment offered by the gentleman from Kentucky [Mr. MAY] requiring the approval of Congress for the disposal of any lands or other property acquired by the Secretary under the act. You will remember that restriction was a provision inserted as an amendment during the consideration of the House bill. I think it was the thought of the House, practically unanimous, that Congress had a right to reassert itself in connection with future legislation in insuring against individuals acting without regard to the legislative branch and its prerogatives. We believe it is a provision which is necessary to the better functioning of this type of development.

The conference agreement contains provisions from the Senate proposals which were not in the House amendment, and which specifically authorized engineering studies to be made in connection with the research and development work, and which also restrict the land and other properties which may be acquired under the act to the quantity necessary for carrying out its provisions.

In other words, only that necessary property which was actually to be used could be purchased. They could not go out by a blanket authority and purchase here and there and buy this and that unneeded land. The Secretary would confine it strictly to the purposes for which the act is intended.

The conference agreement eliminates a provision of the House amendment which exempted leases made under the act from the provisions of sections 321 and 322 of the act of June 30, 1932, and provided that such leases might be made for a term of years notwithstanding section 3679 of the Revised Statutes or any other provision of law. The first part of this provision was eliminated, as there appears to be no necessity for exempting

leases made under this act from the provisions of sections 321 and 322, which are referred to above, which embody certain restrictions with respect to leases made to or by the Government. There appeared to be no necessity for the latter part of this provision, relating to leases for a term of years, as section 2 (b) of the bill specifically authorizes leases for a term of years to be made in order to carry out the purposes of the act.

Mr. Speaker, I personally thank my colleagues for their support of this legislation. I have also appreciated the cooperation of Senator O'MAHONEY, author of the Senate bill. I trust the future will vindicate the action we have taken to keep America secure.

Mr. Speaker, I yield 5 minutes to the gentleman from Kentucky [Mr. ROBSON].

Mr. ROBSON of Kentucky. Mr. Speaker, the chairman of the Committee on Mines and Mining has gone into this matter in great detail and I think has state; clearly and fully what this measure undertakes to accomplish. In the first place, it is brought to the House as a war measure to help win the war. You understand that there are two methods by which we may increase our oil and gas production in this country: One, through the utilization of coal; and two, through the utilization of oil from agricultural and forestry products. I know that many of us who do not live in oil and coal countries have had for sometime considerable concern in our own minds about the future supply of oil and gas. In my section of the country we have an abundance of coal and we have considerable oil. But if this war continues for sometime and uses oil and gas at the rate we have been consuming it, and if we continue to cut down our reserves, one of the important questions that is going to confront us in the future is as to the supply of oil and gas. Germany could not have carried on this war with the success that she has if she had not developed synthetic oil and gas from coal and from plants and trees. Therefore we now know that unless we discover some great pool in the future we are going to have to have our supply of oil and gas from other sources. It must come from coal or from the plant life of the country.

Now, this does not put the Government in the business of producing oil or gas. It simply sets up experimental stations to find out the best methods to secure this oil and gas at the lowest price at which it can be produced. So it is a wise and necessary step for Congress to adopt this resolution. As I recall, it was adopted unanimously by the House and the Senate, and the conferees have carried into this report by unanimous agreement of the conferees, all of the essential points that were in the House and the Senate bills.

Mr. RANDOLPH. Mr. Speaker, will the gentleman yield?

Mr. ROBSON of Kentucky. I yield.

Mr. RANDOLPH. I would like to observe that by the passage of this legislation the Congress will be giving an insurance to the country in the future that we will not be caught in the predicament we were when our crude supplies

of rubber from the Dutch and British were cut off and we had to turn, almost overnight, to the building of a synthetic rubber industry in this country. We are looking ahead, and as the gentleman said, we will be prepared as a nation, not to be an importer of oil, but here at home with our own products to sustain ourselves either in peace or in the exigencies of war.

Mr. ROBSION of Kentucky. We have hundreds of millions of acres of good coal, and we can produce an unlimited supply of oil and gas and it will make our country self-sufficient in those very essential and important commodities.

The SPEAKER pro tempore. The time of the gentleman from Kentucky has expired.

The SPEAKER pro tempore. The question is on agreeing to the conference report.

The conference report was agreed to. A motion to reconsider was laid on the table.

CORRECTION OF THE RECORD

Mr. ANGELL. Mr. Speaker, I ask unanimous consent to correct the RECORD of yesterday. On page 3172, in a question propounded by me, in the second paragraph from the bottom, after the word "domiciled", insert "outside the District of Columbia."

The SPEAKER pro tempore. Without objection, the RECORD will be corrected accordingly.

There was no objection.

EXTENSION OF REMARKS

By unanimous consent, Mr. ROBSION of Kentucky was granted permission to revise and extend his own remarks.

Mr. SADOWSKI. Mr. Speaker, I ask unanimous consent to extend my remarks on two different subjects and to include certain excerpts.

The SPEAKER pro tempore. Is there objection?

There was no objection.

[The matter referred to will appear hereafter in the Appendix.]

Mr. SPARKMAN. Mr. Speaker, I ask unanimous consent to extend my remarks in the Appendix and include therein a newspaper article.

The SPEAKER pro tempore. Is there objection?

There was no objection.

[The matter referred to appears in the Appendix.]

PERMISSION TO ADDRESS THE HOUSE

Mr. SPARKMAN. Mr. Speaker, I ask unanimous consent that on Thursday next, after the conclusion of the day's business and any other special orders that may have been entered, I be permitted to address the House for 30 minutes.

The SPEAKER pro tempore. Is there objection?

There was no objection.

EXTENSION OF REMARKS

Mr. WASIELEWSKI. Mr. Speaker, I ask unanimous consent to extend my own remarks in the RECORD and include an editorial.

The SPEAKER pro tempore. Is there objection?

There was no objection.

[The matter referred to appears in the Appendix.]

AMENDING SECTION 6 OF THE DEFENSE HIGHWAY ACT OF 1941, AS AMENDED

Mr. ROBINSON of Utah. Mr. Speaker, I ask unanimous consent for the immediate consideration of the bill (H. R. 3912) to amend section 6 of the Defense Highway Act of 1941, as amended.

The Clerk read the title of the bill.

The SPEAKER pro tempore. Is there objection to the present consideration of the bill?

Mr. WOLCOTT. Mr. Speaker, reserving the right to object, will the gentleman explain the necessity for this increase in the authorization?

Mr. ROBINSON of Utah. I will be very glad to explain the bill.

This bill has been considered by the Roads Committee, and the bill is unanimously reported from that committee.

The reason for the urgency of the passage of the bill at the present time is brought about through a history of the legislation. I would like to briefly call the attention of the House to that legislation.

In 1941 we passed what is known as the Defense Highway Act. In this act we provided that the Commissioner of Public Roads should be authorized to provide the construction of access roads and the improvement of access roads to military and naval reservations; and also to defense and industry plants. In order to accomplish this purpose we authorized an appropriation at that time of \$150,000,000. That work has been going on since that time. In other words, all the work that is being done in connection with the defense-highway program is certified by the Secretary of War or the Secretary of the Navy to the Commissioner of Public Roads. The Commissioner of Public Roads is then obligated to do this work.

Since the original authorization we amended the act on July 2, 1942, to authorize \$260,000,000, and we thought at that time that that would be sufficient to do the work designed in connection with this defense program. However, it now develops that roads are being damaged, roads used to and from military developments, and there is no money to pay these sums. In order to pay the sums that the Commissioner is already authorized by the Congress to expend, it is necessary now to increase that authorization.

The Commissioner of Roads appeared before our committee and after very careful examination and testimony he proved to the unanimous satisfaction of the committee that it was necessary that we immediately authorize this money so that it could be paid to the people who are doing the work on these roads.

Mr. SABATH. Mr. Speaker, will the gentleman yield?

Mr. ROBINSON of Utah. I yield.

Mr. SABATH. For the information of the House, I will say the Rules Committee has granted a rule on this bill. Con-

sideration of it now will save time. Two gentlemen, especially, from Tennessee, have made an urgent plea for immediate consideration of this bill because many of the roads, not only in Tennessee, but in many other sections, have been destroyed by the heavy trucks used by the Army. In view of that, a rule was granted. If unanimous consent now is granted it will save perhaps 2 hours of our time, because, as I understand, there is no opposition to the bill.

Mr. WOLCOTT. There is no opposition in the committee, and it is a military necessity that this money be authorized as quickly as possible.

Mr. ROBINSON of Utah. I thank both the gentleman from Michigan and the gentleman from Illinois.

Mr. GORE. Mr. Speaker, will the gentleman yield?

Mr. ROBINSON of Utah. I yield.

Mr. GORE. I desire to express my thanks and the appreciation of my colleague from Tennessee [Mr. McCord] for the kind and courteous consideration given by both the chairman of the Rules Committee and the Committee on Roads to our problem.

The SPEAKER pro tempore. Is there objection to the request of the gentleman from Utah [Mr. ROBINSON]?

There was no objection.

The Clerk read the bill (H. R. 3912), as follows:

Be it enacted, etc., That section 6 of the Defense Highway Act of 1941, as amended by the act of July 2, 1942 (23 U. S. C. 106), is hereby further amended by striking out the amount "\$260,000,000" and inserting in lieu thereof "\$290,000,000."

With the following committee amendment:

On page 1, line 6, after the word "thereof", strike out "\$290,000,000" and insert "\$285,000,000."

The committee amendment was agreed to.

The bill was ordered to be engrossed and read a third time, was read the third time, and passed.

Mr. GORE. Mr. Speaker, I was on my feet seeking to offer an amendment to the bill.

The SPEAKER pro tempore. If the gentleman from Tennessee takes that position, the understanding of the Chair was that the bill would be taken up by unanimous consent. Of course, the Chair, in accordance with a statement made last week, would feel that the action which the gentleman from Tennessee has in mind would be a violation of the statement made by the present occupant of the chair to the minority leader.

Mr. GORE. Mr. Speaker, a parliamentary inquiry. Does the arrangement entered into by the present occupant of the chair preclude the offering of an amendment to which no opposition has been voiced?

Mr. ROBINSON of Utah. Mr. Speaker, I have considered the amendment and I think most of the members of the committee have considered the amendment that has been suggested by the Members from Tennessee. As far as I know, there is no opposition to the amendment.

Mr. WOLCOTT. Will the gentleman yield?

Mr. ROBINSON of Utah. I yield.

Mr. WOLCOTT. Will the gentleman explain what the amendment is?

The SPEAKER pro tempore. The Chair is anxious to help, but there are certain limits. If there is going to be any controversy about this bill—

Mr. GORE. Would the Chair indulge the gentleman from Tennessee for a brief statement on the urgency of the situation so that we can see if any opposition develops?

The SPEAKER pro tempore. To be practical in the situation, rather than strictly parliamentary, without objection the Chair recognizes the gentleman from Tennessee for 1 minute.

Mr. FISH. Reserving the right to object, Mr. Speaker, we have been very patient here with all these consent requests. We certainly wish to take up the rule on the bill out of the Committee on Naval Affairs. I hope no more requests of this nature will be made.

The SPEAKER pro tempore. The observation of the gentleman from New York is timely and pertinent.

There was no objection.

The SPEAKER pro tempore. The gentleman from Tennessee is recognized.

Mr. GORE. Mr. Speaker, the rather desperate situation in the maneuver area in Tennessee arises out of the very fact that 26 counties in Tennessee were selected as a permanent maneuver area for the United States Army. Those maneuvers, however, are ending this week. Troops have been maneuvering in this area for several months with the heaviest type of equipment—30- and 34-ton tanks, the heaviest guns, all of the equipment used in the final maneuver training of troops before they go across—and they have completely destroyed miles upon miles of roads. In some instances, children cannot go to school, milk trucks cannot haul milk, nor can the roads be used in any normal manner.

Mr. WOLCOTT. Mr. Speaker, will the gentleman yield?

Mr. GORE. I yield.

Mr. WOLCOTT. This bill has nothing to do with that situation. This is to increase the amounts available for the construction of access roads.

Mr. GORE. May I say, however, that the subject matter of the bill is such as to make pertinent an amendment authorizing sufficient funds to restore these roads.

Mr. WOLCOTT. I may say to the gentleman that this will probably become a very controversial subject. The committee did not have hearings on it.

Mr. GORE. The gentleman is mistaken, for I appeared before the committee myself on it.

Mr. WOLCOTT. We have not had any hearings on this particular question.

Mr. GORE. I am sure the gentleman must have been absent, because I myself appeared before the gentleman's committee on the question.

Mr. WOLCOTT. All right; we will say that hearings were held, but the com-

mittee did not see fit to increase the allocations for that purpose because we had nothing before us from the department that would justify any increase of these funds. We could not therefore accept an amendment such as the gentleman proposes without some report from Mr. McDonald.

Mr. GORE. Mr. McDonald appeared before the gentleman's committee. The gentleman was absent that day. Not only was Mr. McDonald there, but other representatives from the Public Roads Administration were there and representatives from the War Department. The War Department admits responsibility but expresses the preference that it be undertaken by the Public Roads Administration.

Mr. WOLCOTT. I was not there. My attention has not been called to it. I have in mind that it may be necessary to rewrite the formula by which the States are reimbursed for damage to the Federal highway system.

Mr. GORE. There is no intention on the part of the War Department so far as I have been able to find out to shirk the responsibility of restoring the roads. The roads have been utterly devastated by these maneuvers, but the War Department feels, as I understand it, that they have a war to prosecute and that if the Public Roads Administration can do the job then it would be best to have them do it.

Mr. WOLCOTT. I may say to the gentleman very frankly that if his amendment is afforded it will probably cause considerable controversy. This bill itself has been called up under unanimous consent because it was urgently necessary to increase the funds for the construction of access highways. The gentleman's amendment brings in an entirely new question which I do not believe we, under the policy of the minority, can let pass without debate.

Mr. GORE. The access roads are no more necessary or urgent than the repair of roads in this area of Tennessee.

Mr. WOLCOTT. We can bring in another bill on that and we will if it is necessary.

The SPEAKER pro tempore. The bill has already been passed, and a motion to reconsider was laid on the table, but in view of the situation, the gentleman from Tennessee desiring to offer an amendment, if there will be no objection, and I have to put the question, the Chair will ask unanimous consent that the entire proceedings by which the bill was passed be vacated; but the Chair states frankly and wants it clearly understood that the Chair had no knowledge at the time the bill was called up under unanimous consent that any amendment would be offered. It was only on that understanding that the Chair recognized the gentleman; but the Chair will ask unanimous consent that the entire proceedings be vacated, in which event the Chair would then feel constrained not to recognize the gentleman from Utah.

Mr. ROBINSON of Utah. Mr. Speaker, I hope the gentleman from Tennessee will not insist on his amendment, but will let us proceed, because this is the

only way we are going to get the money for these access roads which are needed by so many people.

Mr. GORE. Mr. Speaker, reserving the right to object—

The SPEAKER pro tempore. This may be a little irregular but the Chair will recognize the gentleman from Tennessee for 1 minute.

Mr. GORE. Mr. Speaker, it will not be my purpose to object to the passage of this bill, nor will it be my purpose if the proceedings by which the bill was passed are vacated then to object, nor shall I in any way stand in the way of the passage of this needed bill; but the gentleman from Tennessee cannot refrain from expressing deep regret that the arrangements which have been entered into are adjudged to preclude at this time the consideration of a matter of extreme urgency to the people whom he represents.

The SPEAKER pro tempore. The Chair is sure the gentleman from Tennessee recognizes the legislative situation and appreciates the position the Chair is in.

Under those circumstances, the bill stands as passed.

The gentleman from Illinois [Mr. SABATH] is recognized.

**AUTHORIZING SECRETARY OF THE NAVY
TO PROCEED WITH CONSTRUCTION OF
CERTAIN PUBLIC WORKS.**

Mr. SABATH. Mr. Speaker, I call up House Resolution 469 and ask for its immediate consideration.

The Clerk read as follows:

Resolved, That immediately upon the adoption of this resolution it shall be in order to move that the House resolve itself into the Committee of the Whole House on the state of the Union for the consideration of H. R. 4381, a bill to authorize the Secretary of the Navy to proceed with the construction of certain public works, and for other purposes. That after general debate, which shall be confined to the bill and shall continue not to exceed one hour, to be equally divided and controlled by the chairman and ranking minority member of the Committee on Naval Affairs, the bill shall be read for amendment under the five-minute rule. At the conclusion of the reading of the bill for amendment, the Committee shall rise and report the same to the House with such amendments as may have been adopted, and the previous question shall be considered as ordered on the bill and amendments thereto to final passage without intervening motion except one motion to recommit.

With the following committee amendment:

Page 1, line 8, strike out "one hour" and insert in lieu thereof "two hours."

The committee amendment was agreed to.

The SPEAKER pro tempore. The gentleman from Illinois is recognized for 1 hour.

Mr. SABATH. Mr. Speaker, this rule was given to the former member of the Committee on Naval Affairs, now a member of the Committee on Rules, the gentleman from New York [Mr. DELANEY], who is unavoidably absent, believing that the bill would not be called up before 2 o'clock. In his absence I therefore call it up because it is urgent that we

SYNTHETIC LIQUID FUELS

MARCH 28, 1944.—Ordered to be printed

Mr. RANDOLPH, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany S. 1243]

The committee of conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the Senate recede from its disagreement to the amendment of the House to the text of the bill and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the House amendment insert the following:

That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than five years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, and one or more demonstration plants to produce liquid fuels from agricultural and forestry products, with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid fuel industry and of such size that the combined product of all the plants constructed in accordance with this Act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products. Any activities under this Act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture.

SEC. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work, and with pilot plants and semiworks plants to make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs, necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, license, lease for a term of years or less, or donation, secret processes, technical data, inventions patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to acquire by purchase, lease for a term of years or less, or donation, land, and any interest in land (including easements and leasehold interests), options on real or personal property, and plants and their facilities; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: Provided, however, That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization or any educational institution he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation, in effectuating the purposes of this Act.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, subject to approval by Congress, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this Act; and he shall have authority to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act. Provided, That such licenses are consistent with the terms of the agreements by which such patent rights are acquired. No patent acquired by the Secretary of the Interior under this Act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process covered by such patent, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this Act.

Sec. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this Act. The authority and duties of the Secretary of the Interior under this Act shall be exercised through the Bureau of Mines of the Department of the Interior.

Sec. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this Act.

And the House agree to the same.

That the Senate recede from its disagreement to the amendment of the House to the title of the bill, and agree to the same with an amendment as follows:

Amend the title to read as follows:

An Act authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shales, agricultural and forestry products, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

And the House agree to the same.

JENNINGS RANDOLPH,
JOHN M. ROBSION,
Managers on the part of the House.

JOSEPH C. O'MAHONEY,
CHAN GURNEY,
Managers on the part of the Senate.

STATEMENT OF THE MANAGERS ON THE PART OF THE HOUSE

The managers on the part of the House at the conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1243) authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes, submit the following statement in explanation of the effect of the action agreed upon by the conferees and recommended in the accompanying conference report:

The House amendment to the text struck out all of the Senate bill after the enacting clause. The committee of conference recommends that the Senate recede from its disagreement to the amendment of the House, with an amendment which is a substitute for both the Senate bill and the House amendment, and that the House agree to the same.

The substantive differences between the House amendment and the proposed conference substitute are noted in the following statement:

Both the Senate bill and the House amendment authorized the Secretary of the Interior to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances. The House amendment also specifically authorized the Secretary to construct, maintain, and operate one or more demonstration plants to produce liquid fuels from agricultural and forestry products. The conference agreement retains this provision of the House amendment, but provides that any activities under the act relating to the production of fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture. The Department of Agriculture has been for many years engaged in studying and experimenting with the production of such fuels, and it appears wise to provide that any program carried out under this act relating to fuels from agricultural and forestry products should be fully coordinated and integrated with the existing program of that Department. The Senate bill contained a provision, which was not in the House amendment, which limited the authority of the Secretary of the Interior with respect to the construction, maintenance, and operation of demonstration plants to a period of not more than 5 years. The conference agreement retains this provision.

Section 2 (a) of the Senate bill contained a provision, which was not in the House amendment, specifying that the Secretary of the Interior, in conducting research and development work, is authorized, with pilot plants and semiworks plants, to make engineering studies in order to ascertain lowest costs. The conference agreement retains this provision.

Section 2 (b) of the House amendment included acquisition by license among the methods by which the Secretary is authorized to acquire patent rights and other rights, and would have authorized

the acquisition of interests in lands by condemnation, among other methods. The conference agreement retains the authority to acquire patent and other rights by license, but eliminates the authority to acquire land by condemnation. The conference agreement also retains a provision in this paragraph which was in the Senate bill, but not in the House amendment, and which provides that the maximum quantity of land or any interest therein, or any other property, acquired under the act shall not exceed that necessary to carry out the purposes of the act.

Section 2 (c) and (d) of the House amendment contained provisions, not in the Senate bill, specifically including educational institutions among the organizations which the Secretary is authorized to utilize and with which he is authorized to cooperate. The conference agreement follows the House amendment in this respect.

The House amendment contained a provision, which was not in the Senate bill, and which would have exempted leases made under this act from the provisions of sections 321 and 322 of the act of June 30, 1932, as amended, and would have provided that such leases could be made for a term of years notwithstanding section 3679 of the Revised Statutes, as amended, or any other provision of law. This provision is omitted from the conference agreement, as there appears to be no necessity or justification for exempting these leases from the provisions of sections 321 and 322, referred to above, and the earlier provisions of the bill specifically authorize leases to be made for a term of years.

The conference agreement retains a provision which was in the House amendment, but not in the Senate bill, and which provides that the authority of the Secretary to dispose of any lease or other property acquired under the act shall be exercised subject to approval by Congress.

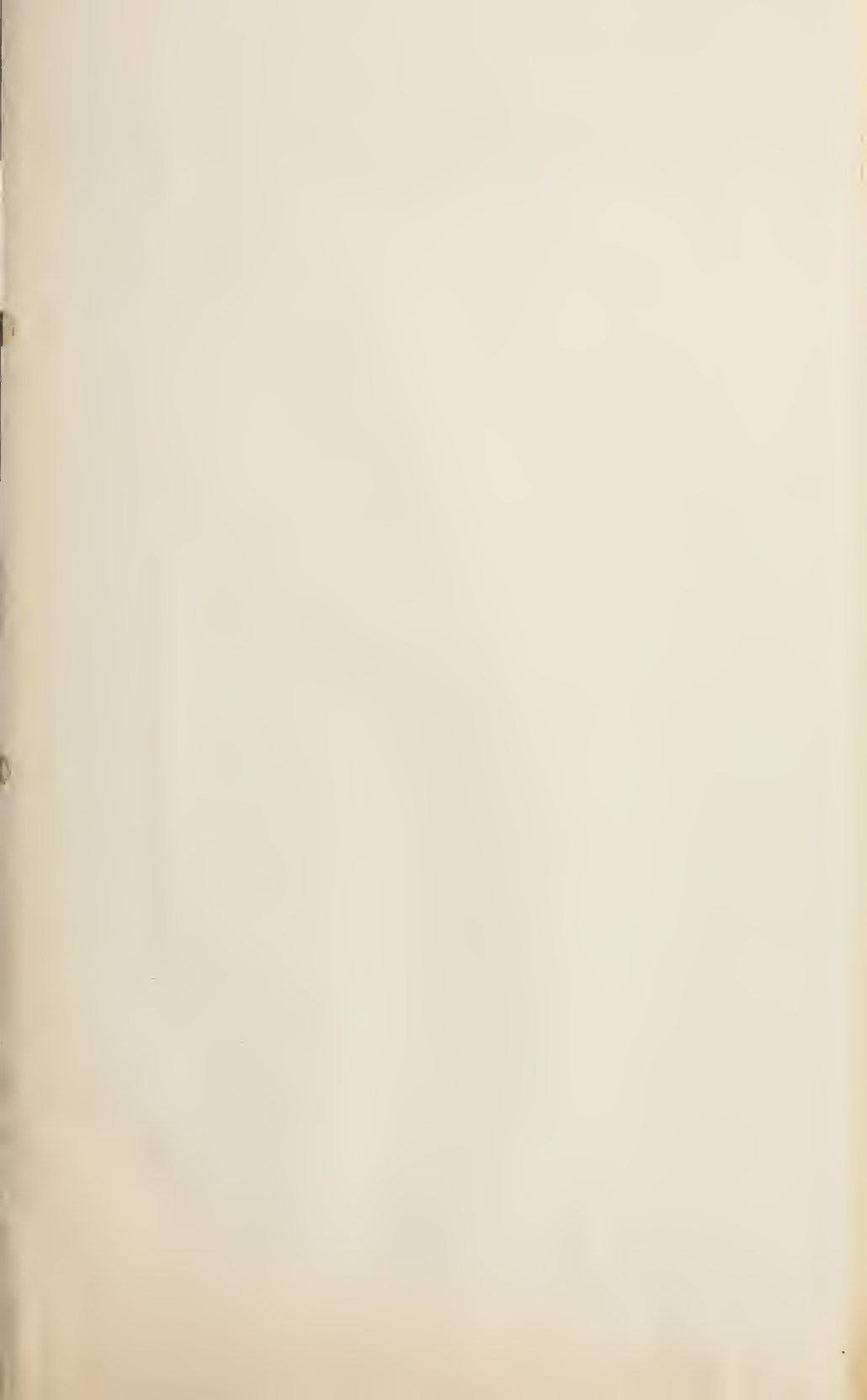
The House amendment contained a provision, which was not in the Senate bill, and which authorized the Secretary to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under the act, if such licenses are consistent with the terms of the agreements by which such patent rights are acquired. The conference agreement retains this provision of the House amendment. The Senate bill contained a provision, which was not in the House amendment, and which provided that no patent or patent rights acquired by the Secretary under the act should prevent any citizen of the United States or any domestic corporation from using any invention, discovery, or process to which such patent or patent rights related, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such citizen or corporation on account of such use. The conference agreement retains this provision in a modified form which makes it applicable only with respect to patents acquired by the Secretary of the Interior under the act. The purpose of this provision is to make available to the citizens and corporations of the United States the use of any inventions, discoveries, and processes which may be invented or discovered in operations under the act, and the use of other inventions, discoveries, and processes covered by patents which are acquired in their entirety by the Secretary under the act. It does not mean that when the Secretary

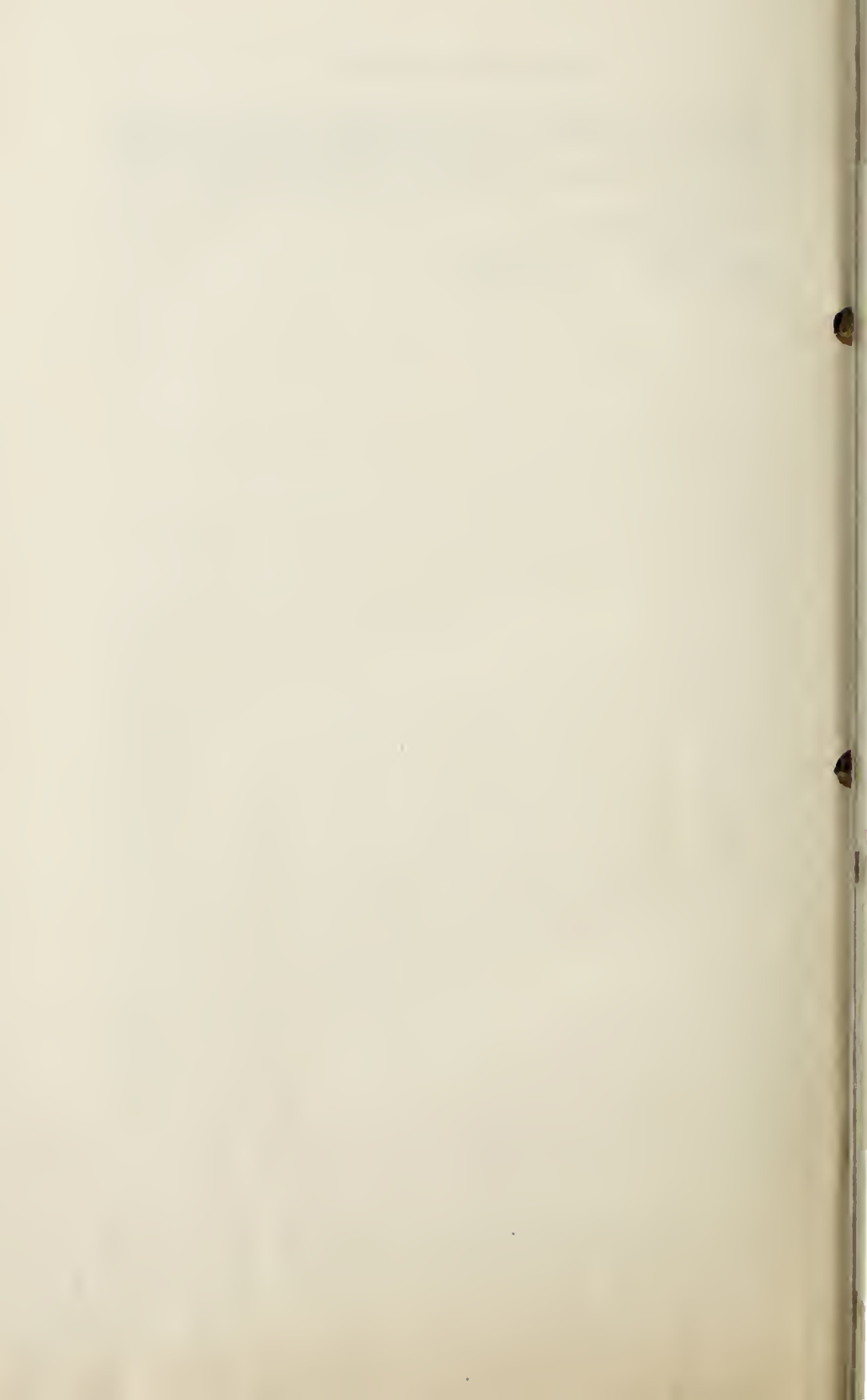
uses a patent under a license from a private owner of such patent, the public will also be permitted to use the patent merely because the Secretary has been licensed to do so.

The conference agreement makes clerical changes in the title of the bill.

JENNINGS RANDOLPH,
JOHN M. ROBSION,
Managers on the part of the House.

C





[PUBLIC LAW 290—78TH CONGRESS]

[PUBLIC LAW 290—78TH CONGRESS]

[CHAPTER 172—2D SESSION]

[S. 1243]

AN ACT

Authorizing the construction and operation of demonstration plants to produce synthetic liquid fuels from coal, oil shales, agricultural and forestry products, and other substances, in order to aid the prosecution of the war, to conserve and increase the oil resources of the Nation, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior, acting through the Bureau of Mines, within the limits of critical materials available, is authorized for not more than five years to construct, maintain, and operate one or more demonstration plants to produce synthetic liquid fuels from coal, oil shale, and other substances, and one or more demonstration plants to produce liquid fuels from agricultural and forestry products, with all facilities and accessories for the manufacture, purification, storage, and distribution of the products. The plants shall be of the minimum size which will allow the Government to furnish industry the necessary cost and engineering data for the development of a synthetic liquid-fuel industry and of such size that the combined product of all the plants constructed in accordance with this Act will not constitute a commercially significant amount of the total national commercial sale and distribution of petroleum and petroleum products. Any activities under this Act relating to the production of liquid fuels from agricultural and forestry products shall be carried out in cooperation with the Department of Agriculture and subject to the direction of the Secretary of Agriculture.

SEC. 2. In order to carry out the purpose of this Act, the Secretary of the Interior is authorized—

(a) to conduct laboratory research and development work, and with pilot plants and semiworks plants to make careful process engineering studies along with structural engineering studies in order to ascertain lowest investment and operating costs, necessary to determine the best demonstration plant designs and conditions of operation;

(b) to acquire, by purchase, license, lease for a term of years or less, or donation, secret processes, technical data, inventions, patent applications, patents, irrevocable nonexclusive licenses, and other rights and licenses under patents granted by this or any other nation; to acquire by purchase, lease for a term of years or less, or donation, land, and any interest in land (including easements and leasehold interests), options on real or personal property, and plants and their facilities; to assume the obligation to pay rentals in advance on property so acquired, and to pay damages arising out of the use of any such property: *Provided, however,* That the maximum quantity of land or any interest therein, or any other property, acquired hereunder shall not exceed that necessary to carry on experiments for the purposes herein provided;

(c) to engage, by contract or otherwise, engineers, architects, and any private industrial organization or any educational institution he deems suitable, to do all or any part of the work of designing, constructing, or operating the plants, the operation to be under his supervision, and through leases or otherwise as he believes advisable;

(d) to cooperate with any other Federal or State department, agency, or instrumentality, and with any private person, firm, educational institution, or corporation, in effectuating the purposes of this Act.

SEC. 3. The Secretary of the Interior is authorized to sell the products of the plants at not more than actual cost, including amortization of capital expenses, as determined by him, to any department, agency, or instrumentality of the Federal or any State government, but priority shall be given to orders placed by the War or Navy Departments. Any remaining products may be sold at going prices to any purchaser through regular commercial channels. The Secretary of the Interior, subject to approval by Congress, shall also have authority to dispose of any lands or other real or personal property acquired, but in his opinion no longer useful, for the purposes of this Act; and he shall have authority to grant, on such terms as he may consider appropriate, licenses under patent rights acquired under this Act: *Provided*, That such licenses are consistent with the terms of the agreements by which such patent rights are acquired. No patent acquired by the Secretary of the Interior under this Act shall prevent any citizen of the United States, or corporation created under the laws of the United States or any State thereof, from using any invention, discovery, or process covered by such patent, or restrict such use by any such citizen or corporation, or be the basis of any claim against any such person or corporation on account of such use.

SEC. 4. All moneys received under this Act for products of the plants and royalties shall be paid into the Treasury as miscellaneous receipts. The Secretary of the Interior shall render to Congress on or before the first day of January of each year a report of all operations under this Act.

SEC. 5. The Secretary of the Interior may issue rules and regulations to effectuate the purposes of this Act. The authority and duties of the Secretary of the Interior under this Act shall be exercised through the Bureau of Mines of the Department of the Interior.

SEC. 6. There is authorized to be appropriated not to exceed the sum of \$30,000,000 to carry out the provisions of this Act.

Approved April 5, 1944.